RAPID TRANSIT FOR THE BAY AREA

THE FOUR-COUNTY SYSTEM

A SUMMARY OF ENGINEERING, FINANCIAL AND ECONOMIC REPORTS SUBMITTED TO THE SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

prepared by
STONE & YOUNGBERG
October 1961

AERIAL STATION, BAY FAIR SHOPPING CENTER

RAPID TRANSIT FOR THE BAY AREA

THE FOUR-COUNTY SYSTEM

A SUMMARY OF ENGINEERING, FINANCIAL, AND ECONOMIC REPORTS SUBMITTED TO THE BAY AREA RAPID TRANSIT DISTRICT

Compiled October 1961 by STONE & YOUNGBERG
Municipal Financing Consultants—San Francisco

PRINCIPAL DISTRICT CONSULTANTS:

Parsons Brinckerhoff-Tudor-Bechtel
(A joint venture composed of Parsons, Brinckerhoff, Quade & Douglas, Tudor Engineering Co., and Bechtel Corporation)
General Engineering Consultants

Smith, Barney & Co.
Financial Consultants

Ebasco Services Incorporated
Economic Consultants

Stone & Youngberg
Financial Adviser

The material in this summary has been drawn from the following principal reports:

Parsons Brinckerhoff-Tudor-Bechtel:
"Engineering Report to the Bay Area Rapid Transit District"—June 1961
"October 1961 Supplement to the June 1961 Engineering Report to the San Francisco Bay Area Rapid Transit District—Four-County System"

Smith, Barney & Co.:
"Financial Report on Proposed San Francisco Bay Area Rapid Transit System (Four-County System)"—October 1961

Ebasco Services Incorporated:
"Rapid Transit System—Economic Review"—June 1961

Stone & Youngberg:
"Financial Impact of Proposed Regional Rapid Transit System on Bay Area Taxpayers and Public Agencies (Four-County System)"—October 1961

Each author of these reports concurs in that portion of this summary pertaining to his report.

DISTRICT DIRECTORS:

ALAMEDA COUNTY
Arnold C. Anderson
Clair W. MacLeod
George M. Silliman
Sherwood Swan

CONTRA COSTA COUNTY
H. L. Cummings
Marvin A. Joseph
Harry L. Morrison, Jr.

MARIN COUNTY
T. J. De Lasaux
M. J. Lamperti

SAN FRANCISCO COUNTY
Allan E. Charles
Arthur J. Dolan, Jr.
Adrien J. Falk
Thomas Gray

SAN MATEO COUNTY
A. J. Bertini
Thomas F. Casey, Jr.
Joseph G. Hunter

DISTRICT OFFICERS:

ADRIEN J. FALK
President

H. L. CUMMINGS
Vice President

JOHN M. PEIRCE
General Manager

ANGUS M. COHAN
Secretary

WALLACE L. KAAPCKE
General Counsel

JOHN J. GOODWIN
Treasurer

HARRY D. ROSS
Controller

TABLE OF CONTENTS

PEAK PERIOD, THE BAYSHORE FREEWAY

INTRODUCTION AND SYNOPSIS

This summary report presents the pertinent facts on a proposal to the San Francisco Bay Area Rapid Transit District for construction of a four-county regional rapid transit system. It summarizes the significant findings, conclusions, and recommendations of the engineering, economic, and financial reports submitted to the District, prior to their adoption by the District Board of Directors and their formal submission to county Boards of Supervisors for hearings.

Reports were prepared and submitted initially on a five-county basis. Questions about the feasibility of operating rapid transit trains on the Golden Gate Bridge have led to development of an alternative four-county plan which excludes Marin County. This summary is based on the four-county system.

The consultants' reports contain the following conclusions as to the basic need for rapid transit in the Bay Area, the proposed plan, the benefits it can bring to the area, the means for its financing, and its costs:

- Growth, decentralization, and specialization have made efficient transportation throughout the Bay Area increasingly essential to its well being. The Bay Area's present highways are deficient in their ability to handle existing traffic and, even with planned improvements (but without rapid transit), highway deficiencies will be greater in 1975.

- The plan proposed is to construct a 103-mile double-track rail system. Modern, lightweight trains would move over the system at high speeds between conveniently located stations.

- The rapid transit system would bring important benefits to the Bay Area by stimulating economic growth, reducing or eliminating highway congestion, and speeding trips for both transit and automobile riders. Benefits will increase steadily in future years along with continued growth of population, economic activity, and travel.

- Construction of the basic rapid transit system is estimated to require a general obligation bond issue of $939,000,000 and a construction period of 8½ years.

- Rolling equipment is to be paid for out of operating revenues, with revenue bonds sold to finance most purchases. A San Francisco-Oakland transit tube under the bay will be financed by the California Toll Bridge Authority and paid for from bridge revenues. Its approaches will be paid for from District operating revenues.

- The system will require a maximum property tax rate of 63 cents per $100 for the general obligation bonds. System operating revenues will be adequate to pay all other costs.

The District's engineering consultants state that construction and operation of a rapid transit system conforming generally to that set forth in the engineering report and supplement is feasible and can be accomplished within the estimated costs set forth. The financial consultants conclude that the system described in the engineering reports is financially feasible.

Here is the summary report on rapid transit: what it is, what it will cost, what it will do.

BASIS FOR THE SUMMARY REPORT

The San Francisco Bay Area Rapid Transit District was created by the California Legislature in 1957 to include all of the counties of Alameda, Contra Costa, Marin, San Francisco, and San Mateo. The studies leading to formation of the District were conducted by the San Francisco Bay Area Rapid Transit Commission, which included representatives of the five District counties, four other Bay Area counties (Napa, Santa Clara, Solano, and Sonoma), and the State of California.

The District is governed by a 16-member Board of Directors appointed by Boards of Supervisors and committees of mayors within the five counties. The District is an independent public agency with its own general manager and staff, and it presently has the authority to levy a tax up to 5 cents per $100 assessed valuation on all taxable property within the District.

Since its formation in 1957 the District's principal function has been to plan a regional rapid transit system. In planning this system the District has been assisted by engineering, financial, and economic consultants and legal counsel.

The law requires that if the District proposes to issue general obligation bonds, certain studies must be made and reports submitted to the county Boards of Supervisors for review and approval before an election is called.

The reports of its engineering, financial, and economic consultants and the District's recommended program must be referred to all the county Boards of Supervisors within the District for their approval. Boards of Supervisors are required to hold hearings 30 to 60 days following the receipt of these reports and vote on the question of approval of the reports within 15 days after the hearing. If all boards approve the reports by majority vote, the District Board must fix the election date and submit a bond proposition to a vote of the electorate.

Any Board of Supervisors may disapprove the reports, and, if so, the District may make additional studies and submit amended reports. If no agree-

AERIAL STATION, ORINDA CROSSROADS

ment is reached within six months from the time the original reports are received, any county not approving the reports may withdraw from the District, as provided in the District Act.

No facilities are located in Marin County in the four-county system. That county may well disapprove the four-county system and withdraw from the District. Reports on which this summary is based exclude consideration of any support from Marin County for the District from taxes, revenues, or any other source. Withdrawal of Marin County would thus have no effect on the conclusions in the reports.

This summary report presents a compilation of pertinent facts from the District's engineering, economic, and financing reports and other sources of information. Its purpose is to aid the Boards of Supervisors and the voters within the District in gaining a better understanding of the Regional Rapid Transit System plan and its costs and benefits.

The District and its consultants have maintained close liaison with cities, counties, and other public and private agencies within the District, and these groups have been kept well-informed on the District's proposals during the time the program was being formulated. Preliminary plans of routes and stations have been submitted by the District to all cities and counties in the Bay Area. Through discussion with various liaison committees and formal public hearings, views of Boards of Supervisors, City Councils, and other bodies have been conveyed to the District Board and are reflected in the reports.

The District's principal consultants have been the following:

General engineering consultant is a joint venture composed of Parsons, Brinckerhoff, Quade & Douglas, of New York City and San Francisco; Tudor Engineering Company, of San Francisco; and the Bechtel Corporation, of San Francisco. Parsons, Brinckerhoff, Quade & Douglas (then Parsons, Brinckerhoff, Hall & Macdonald) served as consultants to the San Francisco Bay Area Rapid Transit Commission, the District's predecessor, in developing many of the basic concepts of regional rapid transit for the Bay Area.

Ebasco Services Incorporated, national firm of engineers and management consultants, served as economic consultants, evaluating the need for and benefits to accrue from a regional rapid transit system. Supplemental studies, including all of those dealing with the economics of the four-county system, were conducted by the District staff.

Smith, Barney & Co., of New York City, is the District's Financial Consultant and responsible for the development of the Financial Plan. Stone & Youngberg, of San Francisco, is Financial Adviser, having conducted studies of the financial impact of the transit plan on taxpayers and public agencies in the District, and is responsible for this summary report. The consultants were advised and assisted by the District's advisory committee on financing, of which Alan K. Browne, Vice President of the Bank of America, is chairman.

The transit proposal has been approved as to legality by Wallace L. Kaapcke, District General Counsel, and by George Herrington, of Orrick, Dahlquist, Herrington & Sutcliffe, the District's special bond counsel.

The following reports are being submitted by the District to the Boards of Supervisors, along

with this summary report, in compliance with terms of the District Act:

Parsons Brinckerhoff-Tudor-Bechtel, "Engineering Report to the San Francisco Bay Area Rapid Transit District," June 1961 and "October 1961 Supplement to the June 1961 Engineering Report — Four-County System."

The June 1961 report was accepted by the District Board on July 27, 1961. Because of questions concerning the use of the Golden Gate Bridge for rapid transit, the District Board directed preparation of new plans and reports on a four-county basis, excluding Marin County.

Ebasco Services Incorporated, "Rapid Transit System Economic Review," June 1961.

Smith, Barney & Co., "Financial Report on Proposed San Francisco Bay Area Rapid Transit System (Four-County System)," October 1961.

Stone & Youngberg, "Financial Impact of Proposed Regional Rapid Transit System on Bay Area Taxpayers and Public Agencies (Four-County System)," October 1961.

Smith, Barney & Co. and Stone & Youngberg submitted reports on the proposed five-county system in June 1961 and July 1961, respectively. Their October reports are revisions of these earlier reports which reflect the change to a four-county system.

The pertinent provisions of the consultants' reports on the four-county system are discussed in greater detail in subsequent sections of this summary report.

The recommended plan contemplates a regional rail rapid transit system with electrically powered trains running on completely grade-separated right of way. The system includes about 103 miles of double-track routes, radiating from the central cities of San Francisco and Oakland. As an integral part of this network, a transit tube beneath San Francisco Bay connects these two cities. Stations are located at major points of passenger origin and destination in all principal communities served, and off-street parking is provided at all stations except in San Francisco and downtown Oakland and Berkeley.

The financing plan consists of three basic parts, with different elements of the system to be financed in different ways and paid for from different sources. The fixed elements of the system, such as land, track and structures, stations, power and control systems, are estimated to cost $937,674,000, including allowances for inflation and pre-operating expenses. These costs are to be financed by District general obligation bonds in a recommended amount of $939,000,000, to be sold between 1962 and 1970.

Rolling equipment for the system, estimated to cost $136,450,000, is to be financed primarily by District revenue bonds secured by a pledge of system gross revenues, with subsequent purchases made directly from surplus net revenues of transit operations.

The Trans-Bay Tube and approaches, estimated to cost $130,508,000, are to be financed by revenue bonds of the California Toll Bridge Authority and secured by a pledge of net bridge revenues. Costs of approaches are to be repaid by the District out of operating revenues.

The District general obligation bond issue is the key to the financing program since the tube and equipment financing cannot be undertaken until after bonds are voted for construction of the basic system.

THE BAY AREA'S NEED FOR RAPID TRANSIT

The San Francisco Bay Area combines characteristics of metropolitan development which make it greatly dependent on effective transportation and communication.

1. The Bay Area is large and growing. The District's population in 1960 was 2,648,800, an 88 per cent increase in twenty years, and an increase of another 1,200,000 is forecast by 1980. The four counties served by the rapid transit system described in this summary include about 94 per cent of total District population. Population of the entire nine-county Bay Area is expected to double by the year 2000, when almost 8,000,000 persons will live here. The table on page 10 summarizes basic population data from the report of Ebasco Services Incorporated, the District's economic consultant.

Bay Area population is dispersed over a large area and yet at the same time is highly concentrated. Because the Bay and surrounding mountains occupy much of the gross area, concentration of population along the shores of the Bay and in nearby valleys is intensified. Transportation is further complicated by the formidable physical barriers presented by the Bay and mountains. The Bay Area has become an important center of finance, trade, and industry largely because of geography and the fact that San Francisco Bay is one of the world's finest harbors. This same bay is, however, the most significant barrier to rapid and effective transportation within the metropolitan area.

PASSAGE THROUGH SIX BAY AREA GATEWAYS *
6 to 9 a.m. and 4 to 7 p.m. on an Average Day

	1954 No.	1959 No.	Percent Change
Person Trips via Public Transit	83,992	71,140	−15%
Person Trips via Private Automobile	266,854	381,105	+43%
Total Person Trips	350,846	452,245	+29%
Total Private Automobiles	154,251	221,573	+44%
Average Number Persons per Private Vehicle	1.73	1.72	No change

* The Golden Gate Bridge is a principal Bay Area gateway and included in this tabulation. The proposed four-county rapid transit system, however, will not provide service across this bridge.

Source: Parsons Brinckerhoff-Tudor-Bechtel

POPULATION DATA, SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

	ACTUAL (000)				PROJECTIONS (000)			
	1930	1940	1950	1960	1965	1970	1975	1980
Rapid Transit District								
Alameda	474.9	513.0	740.3	905.7	1000	1100	1210	1330
Contra Costa	78.6	100.5	299.0	409.0	473	542	624	718
San Francisco	634.4	634.5	775.4	742.9	745	749	757	766
San Mateo	77.4	111.8	235.7	444.4	533	618	690	760
Four-County Total	1265.3	1349.8	2050.4	2502.0	2751	3009	3281	3574
Marin	41.6	52.9	85.6	146.8	180	217	266	316
District Total	1306.9	1412.7	2136.0	2648.8	2931	3226	3547	3890
Other Bay Area Counties								
Napa	22.9	28.5	46.6	65.9	78	92	110	132
Santa Clara	145.1	174.9	290.5	642.3	795	935	1070	1210
Solano	40.8	49.1	104.8	134.6	154	178	214	263
Sonoma	62.2	69.1	103.4	147.4	171	199	237	285
Other Bay Area Counties Total	271.0	321.6	545.3	990.2	1198	1404	1631	1890
Bay Area Total	1577.9	1734.3	2681.3	3638.9	4129	4630	5178	5780

Source: Actual data from U. S. Census Bureau. Projections by Van Beuren Stanbery, presented by Ebasco Services Incorporated in the District economic report.

As population in the Bay Area grows, effective communication among various portions of the Bay Area will become even more essential. Trip lengths will increase, especially the daily journeys to and from work, and intensify daily peak traffic volumes.

2. Decentralization is occurring in population and most classifications of industry in the Bay Area, but at the same time so-called "hard core" activities in the central cities are growing and becoming increasingly vital to the continued economic welfare of the entire area. The central cities are the focal point for finance, trade, commerce, and regional government activities and are the base for the area's service activities.

These development trends are creating greater interdependence among all urban centers and subcenters. Only when facilities and means exist for fast and efficient transportation of goods, services, and people can the area realize its potential development and support the variety of services required.

As evidence of the continuing and growing importance of central cities in the Bay Area, employment in San Francisco increased in the last decade although population declined. The population of San Francisco decreased about 32,500 between 1950 and 1960, but employment rose 22,400 in that period. Had employment declined in proportion to population, San Francisco would have lost 13,000 jobs. San Francisco's employment therefore increased during the 1950's by 35,400 over the level indicated by the city's population.

Considering this growth in comparison with the overall employment pattern for the Bay Area, the economic consultants concluded that more than two-thirds of all employment in San Francisco is such that it cannot readily be decentralized to diversified locations. Similar conclusions can be drawn as to the character of employment in central Oakland and Berkeley. As the area as a whole grows, the importance of the central core cities as hubs will be accentuated and will correspondingly aggravate the problem of transporting in- and out-bound commuters. Centralization of specialized service activities in the geographic centers will increase the need for efficient transportation from the central cities to subcenters in the area.

3. Present traffic trends have been examined by analysis of major gateways, a procedure made possible by the fact that Bay Area geography channels major movements of people.

The District's engineers determined that more than 878,500 persons pass on major routes through six principal gateways (Colma-Bayshore, Golden Gate, Trans-Bay, Cerrito Creek, Berkeley Hills, and San Lorenzo-San Leandro) on trips of more than five miles during an average 24-hour day. The number of persons passing through the gateways on these trips during three-hour peak periods morning and afternoon represents more than 51 per cent of the total daily volume. Passage of persons through these gateways has increased much more rapidly in recent years than the Bay Area's population. Because the number carried by transit is declining (off 15 per cent in five years), the number of persons in automobiles and number of automobiles passing through the gateways are increasing even more rapidly than population or total number of person-trips.

Peak hour traffic increased by 27 percent and automobiles by 44 per cent from 1954 to 1959, a period during which population in the District grew by only about 12 per cent. (See table page 10.)

More than 75 per cent more peak-hour, peak-direction trips through the six gateways can be expected in 1975 than at present. Even with the assumption that public transit continues to carry its present number of passengers, rather than continue its decline, more than 340,000 automobiles are estimated to pass through the six gateways during the six peak hours each day in 1975. All of these figures are for trips of more than five miles, the type best served by rapid transit.

4. Although the Bay Area is confronted with automobile traffic increases of staggering proportions, the area's major traffic gateways were seriously deficient in their ability to handle 1960 volumes. According to the District's engineers, the six major gateways had a combined 1960 capacity deficiency of more than 17,000 persons in the peak hour when compared with standards of free traffic flow used by traffic engineers. "Free flow" is considered an appropriate standard because speeds and travel times are reasonably comparable with those to prevail on the proposed rapid transit system and those customary for automobiles in uncongested off-peak periods.

Even with reconstruction of the Bay Bridge, modifications on the Golden Gate Bridge, and construction of planned new freeways throughout the five Bay Area counties, combined deficiencies will be even greater in 1975. In spite of the substantial increases in highway capacity to be provided, estimates place deficiencies in that year at 38,300 person-trips for the six Bay Area

gateways without rapid transit. Excluding the Golden Gate, unaffected by the four-county transit system, the combined 1975 deficiency at the five other gateways is estimated at 31,700.

As will be discussed subsequently in more detail (see page 29), addition of the proposed four-county rapid transit system to the Bay Area's transportation network will reduce total 1975 deficiencies at the five affected gateways from 31,700 to 3,600 persons, according to the District's engineers, and alleviate congestion so there would be virtually no capacity deficiency for the Peninsula, San Leandro, Berkeley Hills, and Cerrito Creek gateways.

(5) Attention has been given to future travel patterns which may be expected in the Bay Area. Inter-county commuter trips, which are vital to the area's economic health and well-being, are estimated to increase by almost 45 per cent between 1960 and 1975, and not only number of commuters but average trip length will increase. The economic consultants estimate that 244,000 persons will travel to work daily in 1975 across county lines, compared with the 1960 total of about 169,000. Since intra-county commuters, whose number is also increasing, are not included in these figures, the total number of commuters is actually higher.

Alameda and San Mateo Counties each will have four 1975 commuters for every three today, according to the District's economic consultants, and Contra Costa five for every three. The number of Marin County commuters is expected to double. Movements to downtown centers of San Francisco, Oakland, and Berkeley will continue to constitute most of the commuter travel. About 59 per cent of present inter-county commuter trips are into San Francisco and the 1975 percentage is estimated at 55 per cent.

Since the commuters' mass journey morning and evening represents about half of daily interurban movement, it will be a primary determinant of transportation improvements which should be provided.

BASIC CONCEPTS OF RAPID TRANSIT

The recommended rapid transit plan for the San Francisco Bay Area has been developed from several important basic concepts and criteria. The District engineers set standards for transit based on the Bay Area's needs and its special characteristics which affect transportation in this area.

An essential feature of the Bay Area Rapid Transit System is that it is *regional*. The need for a truly regional system was clearly established by the earliest studies of the Rapid Transit Commission. Formation of the District to include all of five counties was further implementation of the regional concept.

While a system also serving Marin County was originally recommended, the four-county system remains regional, serving counties with more than 94 per cent of the present District population.

The recommended system is designed to serve regional needs and primarily to carry inter-county and intercommunity passengers. Although principal service will be for regional movements, the system will offer important benefits for shorter trips.

A second basic concept is that of the *network*. The regional rapid transit system will be but one element of Bay Area transportation. Rapid transit is designed to operate in conjunction with other basic elements: the freeway system, local streets, and local transit. These four elements must all be present and operating effectively if the Bay Area is to have balanced transportation facilities.

Rapid transit is not intended to be nor can it serve as a substitute for the freeway system or any other element of the transportation network. Transit should be planned and operated in close coordination with freeways, and the District plan is based on continuous area-wide coordination in transportation planning, design, and construction.

The rapid transit system must be attractive to its potential patrons if the system is to be successful and fulfill its role as part of the Bay Area transportation complex. The system should be made particularly attractive to people who have automobiles available as alternate means of travel. While rapid transit will complement the automobile as part of the area-wide network, it must at the same time compete with the automobile in comfort and convenience as well as in speed and travel costs.

While standards for rapid transit should insure a high level of passenger comfort, convenience, and dependability, they must not be so high as to result in excessive costs which would threaten the system's financial soundness and acceptability.

According to the District's engineers, construction of the Bay Area rapid transit system in accordance with these concepts and standards would abate motor vehicle congestion on regional

highways and in urban centers, encourage a continued high rate and type of economic development, and preserve and enhance a high living standard.

The engineering report lists some of the salient standards established for the regional system:

- Average operating speeds up to 50 m.p.h., including station stops, requiring maximum speeds of at least 70 m.p.h. between stations.
- Service during peak hours of travel governed by demand, with headways between trains of as little as 90 seconds, permitting movement of 30,000 seated passengers per hour in one direction. Off-peak service, except late at night, at least as frequent as every 15 minutes.
- High standards of safety and dependability.
- Comfortable car in terms of riding qualities, heating, ventilation, and noise level; pleasing appearance inside and out.
- Routes to penetrate major centers of business and commerce and stations to be close to ultimate destination of travelers.
- Acceptable to the public in general and to adjacent property owners in particular, with low external noise level and aesthetically acceptable system structure.
- Minimum capital and operating costs consistent with these specified standards.

TRANSIT EQUIPMENT

The engineers have considered many types of transit systems, including many untraditional proposals, but only one method was found which now meets all the essential requirements and the basic elements of which are thoroughly proved in tests and in operation. This is a system utilizing high-speed, lightweight, stainless steel or aluminum trains supported on steel wheels and operating over continuous steel rails under automatic train control.

Equipment research is continuing, but any other system would be required to demonstrate clearly its ability to perform as well as the best of conventional systems, and at equal or lesser cost, before being adopted by the District.

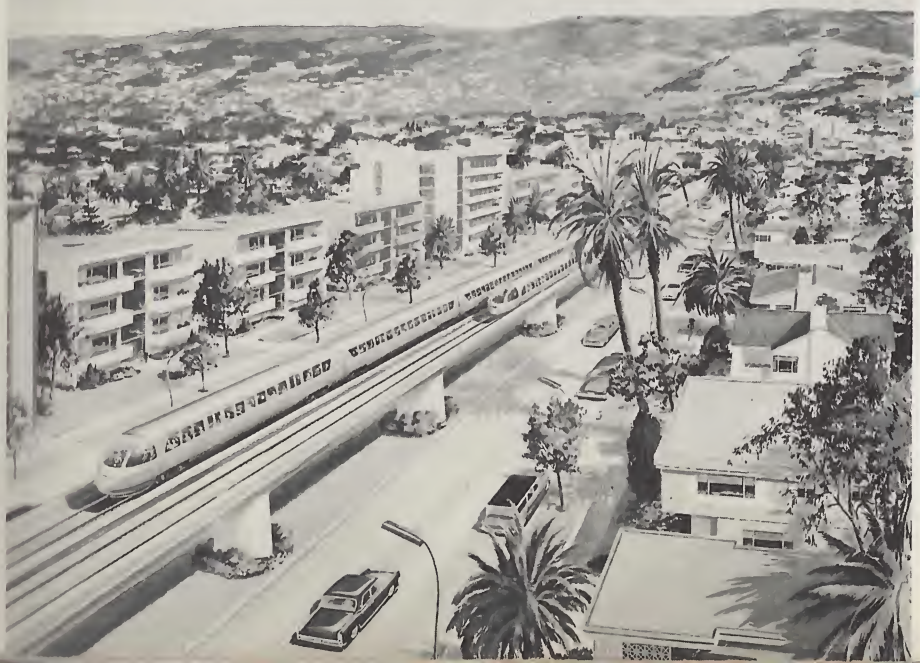
Several untraditional transit methods have been studied, including those commonly referred to as "monorail," but all were found today to have deficiencies in construction or operation in comparison with the high-speed, lightweight, supported system selected by the engineers as the basis for present estimates.

The true monorail system, a car suspended from a single rail, is not well suited for this system because of uncontrolled sway on curves which would make it difficult or impossible to use in confined areas such as subways, tunnels, and tubes, or at station platforms.

All known power and propulsion systems have been studied by the District's engineers. The fundamental system of power and propulsion decided upon for study and estimate employs direct current electric motors mounted on each axle of each transit car. Alternating-current power is to be converted at trackside substations, and direct current supplied to trains from a third rail. As with basic equipment, propulsion research is continuing, but any other system will be adopted only if clearly superior to that used in the estimates.

'While rapid transit will complement the automobile as part of the area-wide complex, it must at the same time compete with the automobile . . . in comfort and convenience as well as in speed.'

AERIAL OPERATION, BERKELEY



REGIONAL ROUTES

To satisfy one of the most important basic criteria, the proposed rapid transit system is genuinely regional. Travel patterns in the Bay Area are determined largely by topography, a factor which seriously limits many types of movements. The plan of routes has been developed to accommodate this travel

pattern and is adjusted to the topography of the region. Lines radiate from the central cities of San Francisco and Oakland into major populated areas, and a tube under San Francisco Bay connects the two major urban centers.

Adjustments may be made in final design and construction as a result of many causes. The plan presented here and in the engineering report and supplement is that which will be generally followed by the District subject to changes which may become advisable in light of future conditions.

From San Francisco one line runs south along the San Francisco Peninsula as far as Palo Alto and one line entirely in San Francisco runs from downtown west through the Western Addition into the Richmond district. Three lines radiate from downtown Oakland: north to Berkeley and Richmond, east through the Berkeley Hills into central Contra Costa County, and south as far as Fremont.

The extensive regional system requires about 103 miles of two-track routes with 50 stations. Three principal forms of construction are proposed: 20 miles of subway, tunnel, or tube; 40 miles of aerial structure; and 43 miles of construction on the surface.

A system map showing the proposed routes and station locations is shown on the next page.

Route mileages and station locations are summarized in the table on page 16.

The **San Francisco Downtown** section of the transit system consists of a four-track, two-level subway beneath Market Street with stations for both levels at Montgomery Street, Powell Street, and Civic Center.

The lower level of the Market Street subway will be used for the District's regional transit trains. It will join the Trans-Bay Tube at the Ferry Building and, near Van Ness Avenue, leaves Market Street and swings south to become the Peninsula Line. The San Francisco Geary Line joins the Market Street subway at the Market and Montgomery station. Trains from both the Peninsula and Geary Lines will operate through the Trans-Bay Tube to the East Bay.

The Market Street upper level subway, between Second Street and Gough Street, is designed for future rapid transit use but will be used initially by street cars of the San Francisco Municipal Railway. Removing street cars from the surface on Market Street is expected to eliminate a serious bottleneck in the Municipal Railway system and improve vehicular movement.

The **Peninsula Line** runs from San Francisco Downtown south along Mission Street and the route of the Southern Freeway to Daly City and parallels Southern Pacific railroad right of way on the surface for most of its distance through San Mateo County. From San Bruno to Palo Alto the transit line is immediately west of the Southern Pacific main line.

Transit construction in San Mateo County will be undertaken concurrently with a program of grade crossing elimination which includes State financial participation. Twenty-three grade separations will be constructed to separate both rail and transit lines from major surface streets.

The **Geary Line** runs westerly through San Francisco from Market and Montgomery Streets to 25th Avenue and Geary Boulevard. The route is principally subway under Post Street and aerial structure in Geary Boulevard west of Spruce Street. Trains will run directly between the Geary Line and the Trans-Bay Line. Service can be extended to Marin County in the future by connection from the Golden Gate Bridge to the Geary Line at any one of several points.

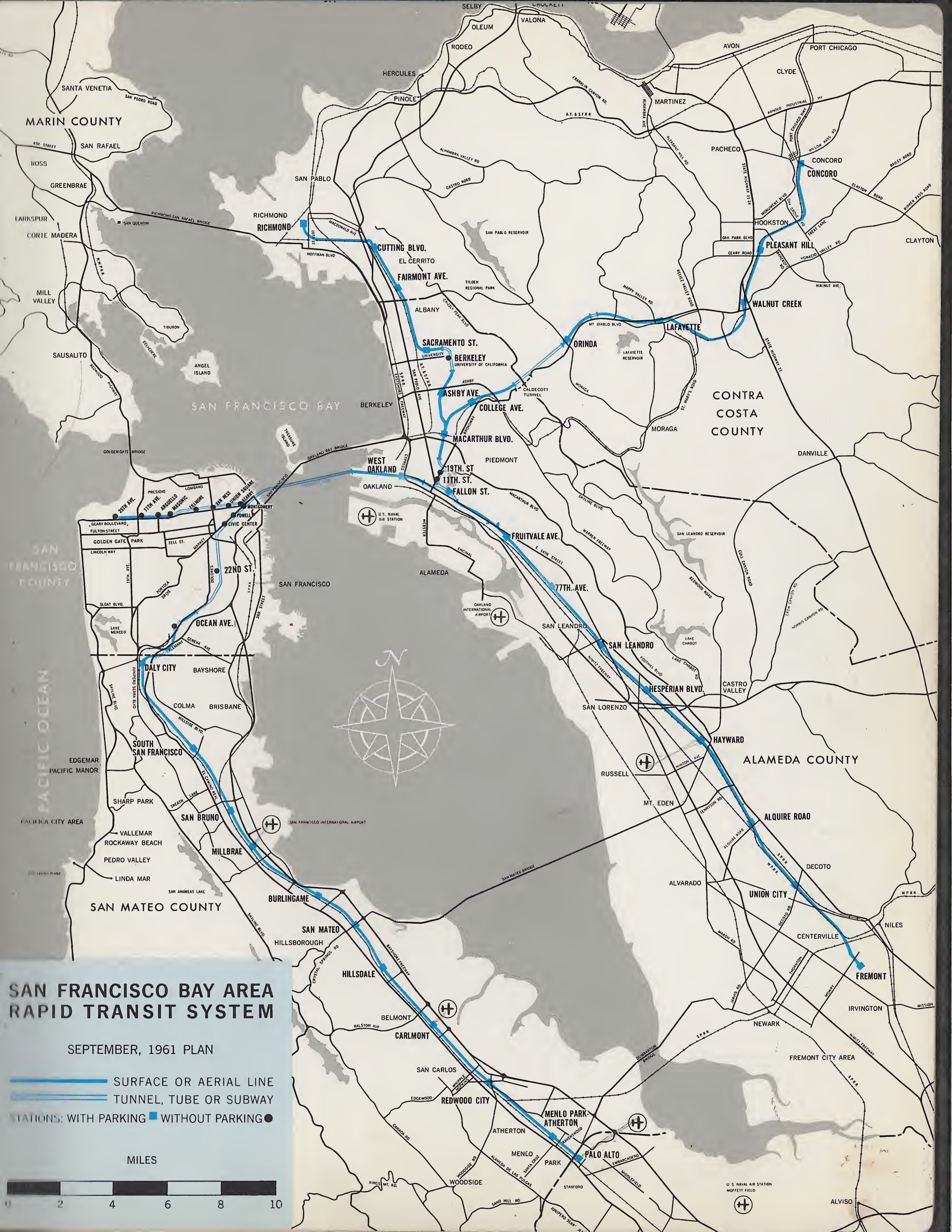
A very important and heavily traveled section of the regional rapid transit system will be the **Trans-Bay Line** joining San Francisco and Oakland. This line consists of a subaqueous tube beneath San Francisco Bay and the approaches to the tube.

The Trans-Bay Line leads from the lower level of the Market Street Subway under the Ferry Building to the main underwater tube structure. The alignment passes immediately east of the concrete central anchorage of the Bay Bridge and comes to the surface on the Oakland Mole. The Oakland approach runs along Seventh Street from the Mole to the West Oakland Station.

The tube and approaches are to be financed by the California Toll Bridge Authority under special legislative authorization, as discussed separately in a later section.

The **Oakland Downtown** section will be primarily subway construction. The heart of the Oakland complex will be a three-track, two-level subway under Broadway with stations at 11th Street and 19th Street.

Major junction will be at the 11th Street Station. Trains from the Trans-Bay Line turn north here to pass through the Broadway subway to the Berkeley-Richmond and Central Contra Costa Lines. The Southern Alameda County Line swings south in subway from the 11th Street Station. Trains may also run through the Broadway subway between the Southern Alameda


SAN FRANCISCO BAY AREA
RAPID TRANSIT SYSTEM
SEPTEMBER, 1961 PLAN
SURFACE OR AERIAL LINE
TUNNEL, TUBE OR SUBWAY
STATIONS: WITH PARKING WITHOUT PARKING
MILES
0 2 4 6 8 10
MARIN COUNTY
SAN FRANCISCO BAY
CONTRA COSTA COUNTY
ALAMEDA COUNTY
SAN MATEO COUNTY
SAN FRANCISCO COUNTY
PACIFIC OCEAN
RICHMOND
CUTTING BLVD.
FAIRMONT AVE.
SACRAMENTO ST.
BERKELEY
ASHBY AVE.
COLLEGE AVE.
MACARTHUR BLVD.
19TH. ST
11TH. ST.
FALLON ST.
WEST OAKLAND
FRUITVALE AVE.
77TH. AVE.
SAN LEANDRO
HESPERIAN BLVD.
HAYWARD
ALQUIRE ROAD
UNION CITY
FREMONT
ORINDA
LAFAYETTE
WALNUT CREEK
PLEASANT HILL
CONCORD
MONTGOMERY
POWELL
CIVIC CENTER
22ND ST.
OCEAN AVE.
DALY CITY
SOUTH SAN FRANCISCO
SAN BRUNO
MILLBRAE
BURLINGAME
SAN MATEO
HILLSDALE
CARLMONT
REDWOOD CITY
MENLO PARK-ATHERTON
PALO ALTO
25TH AVE.
11TH AVE.
ARGUELLO
MASONIC
FILLMORE
VAN NESS
UNION SQUARE
CALDECOTT TUNNEL
GOLDEN GATE BRIDGE
OAKLAND BAY BRIDGE
SAN MATEO BRIDGE
DUMBARTON BRIDGE
SAN FRANCISCO INTERNATIONAL AIRPORT
OAKLAND INTERNATIONAL AIRPORT
U.S. NAVAL AIR STATION
U S NAVAL AIR STATION MOFFETT FIELD
SAN RAFAEL
SAUSALITO
MILL VALLEY
ANGEL ISLAND
ALAMEDA
OAKLAND
SAN FRANCISCO
EL CERRITO
ALBANY
PIEDMONT
MORAGA
DANVILLE
MARTINEZ
PACHECO
CLAYTON
CASTRO VALLEY
SAN LORENZO
MT. EDEN
RUSSELL
ALVARADO
DECOTO
CENTERVILLE
NILES
IRVINGTON
NEWARK
FREMONT CITY AREA
ALVISO
BAYSHORE
BRISBANE
COLMA
EDGEMAR
PACIFIC MANOR
SHARP PARK
PACIFICA CITY AREA
VALLEMAR
ROCKAWAY BEACH
PEDRO VALLEY
LINDA MAR
HILLSBOROUGH
BELMONT
SAN CARLOS
ATHERTON
MENLO PARK
WOODSIDE
STANFORD

County Line and either of the other East Bay lines.

The **Berkeley-Richmond Line** emerges from the Broadway subway at Telegraph and West Grand Avenues in Oakland and continues along the median of the proposed Grove-Shafter Freeway to 45th Street. The line then continues along Grove and Adeline Streets on aerial structures in street medians and passes through downtown Berkeley in subway in Shattuck Avenue. The line then follows Hearst Avenue and the Santa Fe Railway right of way to a terminus at the Richmond Station on Macdonald Avenue between 5th and 6th Streets.

The **Central Contra Costa Line** operates along the same route as the Berkeley-Richmond Line leaving downtown Oakland and joining the median of the Grove-Shafter Freeway. While the Berkeley-Richmond Line leaves the freeway north of MacArthur Station, the Central Contra Costa Line remains at grade in the median of the freeway until it enters a long tunnel through the Berkeley Hills to Orinda. In Contra Costa County the line is generally parallel to State Highway 24 between Orinda and Lafayette and along the abandoned Sacramento Northern right of way through Lafayette and Walnut Creek to Pleasant Hill and to a Concord terminus.

The **Southern Alameda County Line** extends from the Fallon Street Station in downtown Oakland generally parallel to the Western Pacific railroad line south through Oakland, San Leandro, San Lorenzo, Hayward, and Union City as far as Alameda Creek, 2.4 miles south of Decoto Road, and then follows private right of way to its terminus at Fremont.

ROUTES AND STATIONS
SAN FRANCISCO BAY AREA REGIONAL RAPID TRANSIT SYSTEM

SAN FRANCISCO DOWNTOWN AND PENINSULA LINE

Mileage*	Station
	SAN FRANCISCO
0	Montgomery Street
0.4	Powell Street
0.9	Civic Center
1.3	Van Ness Avenue (upper level only)
2.7	22nd Street
6	Ocean Avenue
	SAN MATEO COUNTY
8	Daly City
12	South San Francisco
14	San Bruno
16	Millbrae
19	Burlingame
21	San Mateo
23	Hillsdale
26	Carlmont
29	Redwood City
32	Menlo Park-Atherton
33	Palo Alto (Santa Clara County)

BERKELEY-RICHMOND LINE

Mileage*	Station
	OAKLAND
0	11th Street
0.5	19th Street
2.1	MacArthur
	BERKELEY
4	Ashby Ave.
5	Berkeley
6	Sacramento St.
	CONTRA COSTA COUNTY
8	Fairmont Ave.
10	Cutting Blvd.
13	Richmond

CENTRAL CONTRA COSTA LINE

Mileage*	Station
	OAKLAND
0	11th Street
0.5	19th Street
2.1	MacArthur
4	College Ave.
	CONTRA COSTA COUNTY
8	Orinda
12	Lafayette
16	Walnut Creek
18	Pleasant Hill
22	Concord

GEARY LINE

Mileage*	Station
	SAN FRANCISCO
0	Kearny St.-Montgomery St.
0.3	Union Square
1.0	Van Ness Ave.
1.6	Fillmore St.
2.6	Masonic Ave.
3	Arguello Blvd.
4	11th Ave.
5	25th Ave.

TRANS-BAY LINE

Mileage*	Station
0	Montgomery St. (San Francisco)
6	West Oakland
8	11th St. (Oakland)

SOUTHERN ALAMEDA COUNTY LINE

Mileage*	Station
	OAKLAND
0	11th Street
0.7	Fallon St.
4	Fruitvale Ave.
6	77th Avenue
	SOUTHERN ALAMEDA COUNTY
8	San Leandro
11	Hesperian Blvd.
14	Hayward
18	Alquire Road
20	Union City
24	Fremont

*West Bay and Trans-Bay mileages are shown from Montgomery St. Station, East Bay from 11th Street Station in Oakland.
Distances under three miles are shown to the nearest 0.1 mile, others to the nearest mile.

TRANSIT STRUCTURES

The regional rapid transit system will include about 43 miles of construction on the surface, 40 on aerial structures, and 20 miles of subways and tunnels, including the Trans-Bay Tube. A completely grade-separated right of way is provided throughout the system.

The choice among the types of structures is dictated by topography, existing structures, and type of surrounding development. Construction at grade is preferred where feasible because of its relatively lower cost, but topography, land costs, and costs of providing grade separations for cross streets make use of other structures either necessary or preferable for most of the system mileage. Subways are recommended for the major downtown centers because of high land cost and congested streets.

Construction at grade can be used alongside railroad tracks, in abandoned railroad rights of way, in locations such as the medians of the Grove-Shafter and Southern Freeways, and in private right of way in rural areas. In some instances open-cut construction may be used as a modification of construction at grade.

Aerial structures will represent a nearly complete departure from the outmoded "elevated" line used in some major cities. The structure proposed for the Bay Area will consist of prestressed reinforced concrete with spans of 60 to 100 feet between single-column bents. Concrete parapets will be used to reduce noise. Aerial structures may be used in medians of wide streets, along railroads or freeways, and on private right of way. This type of structure is economical in its right of way requirements and is considered entirely acceptable in streets with at least 100 feet between building lines. Areas under the overhanging structure are useful for streets, parking, and other purposes.

Subways will usually be built by cut-and-cover methods and will be close to the street surface in order to offer the greatest convenience for passengers. The basic design of the subway structure is a reinforced concrete box section. Various subway configurations will be used, involving from two to four tracks, one or two levels, and construction with and without pedestrian mezzanines. Most of the Market Street subway in San Francisco will consist of two levels, with regional transit trains on the lower level and street cars of the Municipal Railway on the top level. A two-level subway is proposed for downtown Oakland to facilitate junction among the four lines converging there and a single-level subway is proposed for Berkeley.

Continuous pedestrian mezzanines are proposed in downtown San Francisco and Oakland to aid in collecting and distributing passengers, to improve access to adjacent buildings, and to permit safer pedestrian crossing of streets.

Tunnels will be used in several locations where required by topography. The longest tunnel will be through the Berkeley Hills on the Central Contra Costa Line.

A precast concrete tube with a metal shell is recommended for the underwater section of the Trans-Bay Tube.

STATIONS AND RELATED FACILITIES

The proposed regional rapid transit system has a total of 50 stations, located near major points of passenger origin and destination. Stations in downtown districts are located so as to deliver passengers generally within walking distance of most business centers. Parking facilities are not provided in connection with 17 San Francisco and downtown Oakland and Berkeley stations on the system, but these high-volume stations are designed to handle large pedestrian volumes efficiently.

The 33 stations outside central core areas are designed with adequate parking and loading accommodations because most patrons are expected to arrive at or leave these stations by automobile or local transit. Their off-street parking lots have capacities ranging from 400 to 2,000 cars. Total capacity of the 33 station parking facilities is more than 36,000 stalls.

Convenient access will be a controlling requirement in design and location of all stations, and attractive architectural treatment is considered essential. All stations are to have platforms designed to accommodate trains 700 feet long, and roofed cover will be provided over half the platform length. Aerial and subway stations will have both stairways and reversible escalators. Mezzanines and underpasses will provide convenient means for pedestrians to cross over or under the tracks.

SYSTEM OPERATIONS

The standards adopted for the Bay Area Regional Rapid Transit System impose strict requirements for safety and dependability. High speeds and short headways between trains are essential to the success of the system. To achieve the desired results train operation will be automatic, utilizing modern advances in computer technology.

The integration of all control, operation, and fare-collection functions into an automatic system is perhaps the most significant development included in this modern concept of rapid transit. The control system involves application of the most advanced forms of industrial computers. While no system performing all of these functions is now in operation, most of the system components are now being used successfully, and the feasibility of the proposed control system is established.

Train control will be fully automatic. An attendant will be aboard each train to monitor train controls and to act in case of emergency. The automatic train control system will start trains from storage points, move trains at safe speeds and with proper spacing, stop trains at the stations and start them when loaded, and set all switches.

The control system and the standards under which it operates are designed to provide the safe, fast, and comfortable service necessary for the system to attract maximum patronage and offer maximum benefits to the community.

Yards will be located generally at or near the outer ends of the radial routes, with central shops and administration headquarters near the Oakland end of the Trans-Bay Tube. Trains will normally operate from the end of one line to the end of another: from Concord to Palo Alto or Fremont to Richmond, for instance. Greater variety of service will be offered in peak hours, with all lines operating through the Trans-Bay Tube with direct service to Oakland and San Francisco. To accommodate heavy demand in the core areas, provision will be made for turning trains back at points short of the end of a line, permitting more frequent service to close-in stations.

An automatic fare collection system will offer great convenience to patrons and increase the attractiveness of the system. The modern control system also permits use of a fare structure under which the fare for each trip is based on its length.

Regular patrons of the system will use charge account cards, to be inserted in identification devices. Passengers will be billed monthly on the basis of mileage traveled on transit.

FARES AND PEAK-HOUR TRAVEL TIMES BETWEEN TYPICAL SYSTEM POINTS

	SAN FRANCISCO Montgomery St.		OAKLAND 11th St.	
Oakland - 11th St.	35c	8 min.		
Berkeley	50c	16 min.	25c	8 min.
Hayward	65c	25 min.	40c	17 min.
Orinda	55c	18 min.	25c	10 min.
San Francisco-25th Ave.	25c	9 min.	45c	17 min.*
San Mateo	50c	26 min.	75c	34 min.

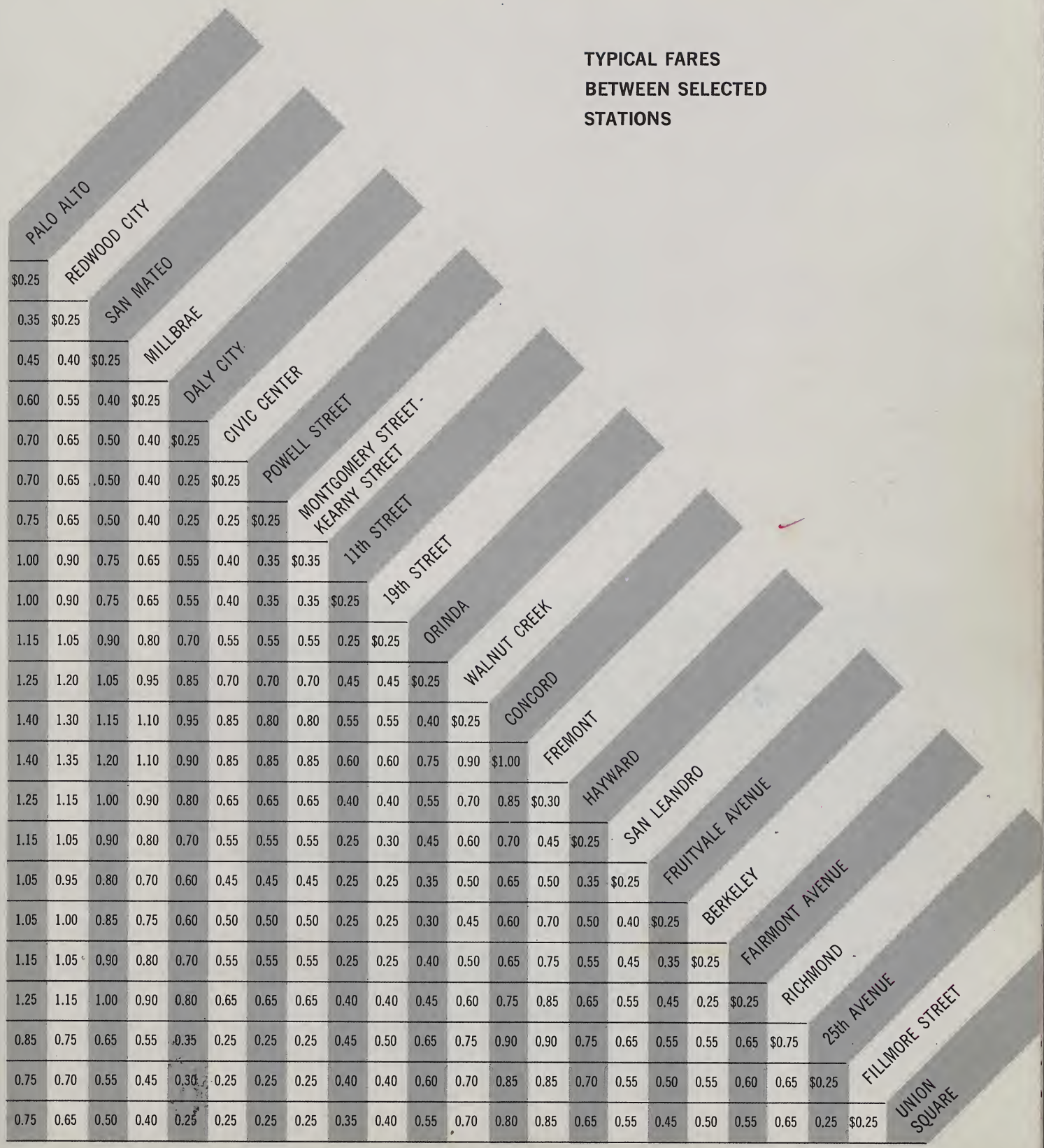
*Plus transfer time between lines, if any.

FARES AND TRAVEL TIMES

Expected travel times on the rapid transit system and the proposed fares are shown at the left for typical trips. The trip between Montgomery Street in San Francisco and Eleventh Street in Oakland will require only eight minutes during the peak hour, and the fare will be 35 cents.

The Transit District fare schedules are designed to compare favorably with costs of alternate forms of transportation, especially the automobile. The level of transit fares is equated basically to the out-of-pocket cost of travel by automobile. A lower level of fares, while likely to

TYPICAL FARES BETWEEN SELECTED STATIONS



PALO ALTO	REDWOOD CITY	SAN MATEO	MILLBRAE	DALY CITY	CIVIC CENTER	POWELL STREET	MONTGOMERY STREET - KEARNY STREET	11th STREET	19th STREET	ORINDA	WALNUT CREEK	CONCORD	FREMONT	HAYWARD	SAN LEANDRO	FRUITVALE AVENUE	BERKELEY	FAIRMONT AVENUE	RICHMOND	25th AVENUE	FILLMORE STREET	UNION SQUARE
$0.25																						
0.35	$0.25																					
0.45	0.40	$0.25																				
0.60	0.55	0.40	$0.25																			
0.70	0.65	0.50	0.40	$0.25																		
0.70	0.65	0.50	0.40	0.25	$0.25																	
0.75	0.65	0.50	0.40	0.25	0.25	$0.25																
1.00	0.90	0.75	0.65	0.55	0.40	0.35	$0.35															
1.00	0.90	0.75	0.65	0.55	0.40	0.35	0.35	$0.25														
1.15	1.05	0.90	0.80	0.70	0.55	0.55	0.55	0.25	$0.25													
1.25	1.20	1.05	0.95	0.85	0.70	0.70	0.70	0.45	0.45	$0.25												
1.40	1.30	1.15	1.10	0.95	0.85	0.80	0.80	0.55	0.55	0.40	$0.25											
1.40	1.35	1.20	1.10	0.90	0.85	0.85	0.85	0.60	0.60	0.75	0.90	$1.00										
1.25	1.15	1.00	0.90	0.80	0.65	0.65	0.65	0.40	0.40	0.55	0.70	0.85	$0.30									
1.15	1.05	0.90	0.80	0.70	0.55	0.55	0.55	0.25	0.30	0.45	0.60	0.70	0.45	$0.25								
1.05	0.95	0.80	0.70	0.60	0.45	0.45	0.45	0.25	0.25	0.35	0.50	0.65	0.50	0.35	$0.25							
1.05	1.00	0.85	0.75	0.60	0.50	0.50	0.50	0.25	0.25	0.30	0.45	0.60	0.70	0.50	0.40	$0.25						
1.15	1.05	0.90	0.80	0.70	0.55	0.55	0.55	0.25	0.25	0.40	0.50	0.65	0.75	0.55	0.45	0.35	$0.25					
1.25	1.15	1.00	0.90	0.80	0.65	0.65	0.65	0.40	0.40	0.45	0.60	0.75	0.85	0.65	0.55	0.45	0.25	$0.25				
0.85	0.75	0.65	0.55	0.35	0.25	0.25	0.25	0.45	0.50	0.65	0.75	0.90	0.90	0.75	0.65	0.55	0.55	0.65	$0.75			
0.75	0.70	0.55	0.45	0.30	0.25	0.25	0.25	0.40	0.40	0.60	0.70	0.85	0.85	0.70	0.55	0.50	0.55	0.60	0.65	$0.25		
0.75	0.65	0.50	0.40	0.25	0.25	0.25	0.25	0.35	0.40	0.55	0.70	0.80	0.85	0.65	0.55	0.45	0.50	0.55	0.65	0.25	$0.25	

improve patronage somewhat, would probably result in less than optimum revenue.

The minimum fare is to be 25 cents, which will apply for any trip of eight miles or less. For longer trips the rate per mile will decline as distance increases, from 3.2 cents per mile for an eight-mile trip to a minimum of 2.25 cents per mile for the longest possible trip. Ten cents is added for each trip using the Trans-Bay Tube.

PATRONAGE, REVENUES, AND EXPENSES

Detailed traffic studies were made by the District's engineers as a basis for estimating patronage on the rapid transit system, and other comprehensive studies made over the past 15 years were reviewed. Total annual traffic volumes were projected to 1975 and the following years, and extensive research was conducted to establish ratios of traffic diversion likely to result from availability of a modern rapid transit system.

Estimates of total system patronage were prepared for each year from 1968 through 1980, with estimates for years prior to 1971 based on sections of the system entering service in accordance with the construction program. These patronage estimates formed the basis for estimating District rolling stock requirements and annual operating revenues and expenses.

Estimated diversions from automobiles to rapid transit were based on intensive research by the District's engineers. After extensive analysis of vehicle registration, personal income, travel time, cost, distance, and other factors which might affect the choice between automobile and transit, the engineers concluded that, since the transit fares would generally be equated with out-of-pocket automobile costs, travel time would be the controlling factor in the choice.

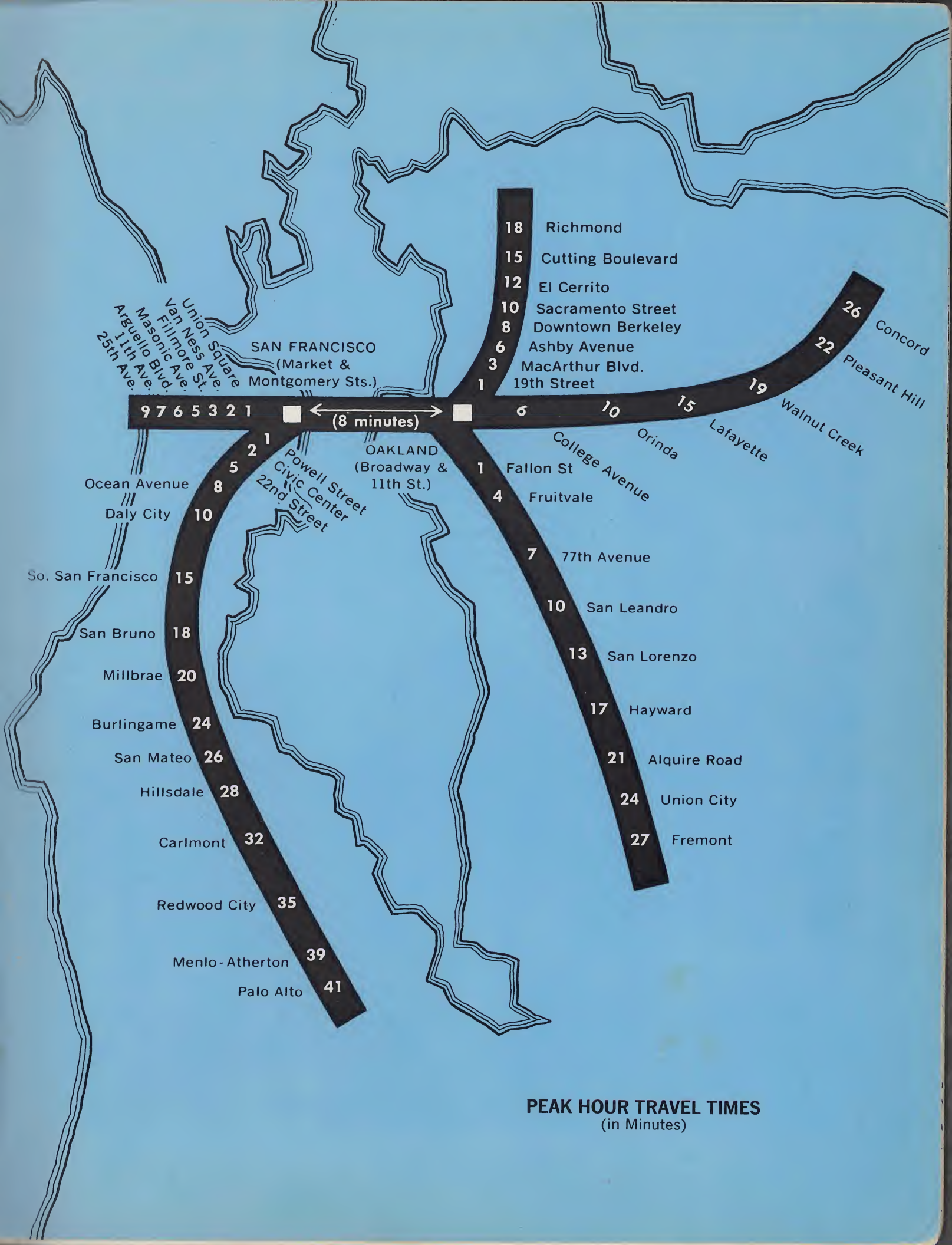
As an example, the transit diversion curves show that if a peak-period regional trip to work in a major downtown area could be made in the same time by automobile as by transit, 77 per cent of these trips would be made by transit. Diversion to transit is, of course, higher if the time advantage of transit is greater and lower if there is less time advantage or if the trip is of another basic type. Proportional transit use would be smaller for trips made for other than work purposes.

The estimates of patronage are based on several assumptions set forth in the engineering report, several of which are recited here. The District's engineers have assumed that all transit service in the Bay Area

ESTIMATED PATRONAGE, REVENUE, AND EXPENSE—REGIONAL RAPID TRANSIT SYSTEM
FOUR-COUNTY SYSTEM

Fiscal Year	Total Passenger Trips	Gross Fare and Concession Revenue	Total Operating and Pre-Operating Expense	Net Operating Revenue
1968/69	86,156,000	$29,259,000	$18,285,000	$10,974,000
1969/70	96,076,000	33,596,000	20,127,000	13,469,000
1970/71	101,897,000	35,950,000	20,421,000	15,529,000
1971/72	106,318,000	37,607,000	21,613,000	15,994,000
1972/73	109,091,000	38,804,000	22,171,000	16,633,000
1973/74	110,531,000	39,415,000	22,480,000	16,935,000
1974/75	111,643,000	39,883,000	22,698,000	17,185,000
1975/76	112,612,000	40,293,000	22,894,000	17,399,000
1976/77	113,598,000	40,712,000	23,090,000	17,622,000
1977/78	114,534,000	41,104,000	23,294,000	17,810,000
1978/79	115,484,000	41,522,000	23,489,000	18,033,000
1979/80	116,398,000	41,912,000	23,670,000	18,242,000
1980/81	117,335,000	42,309,000	23,874,000	18,435,000

Source: Parsons Brinckerhoff-Tudor-Bechtel.



PEAK HOUR TRAVEL TIMES
(in Minutes)

will be coordinated with regional rapid transit, with many local transit lines utilized as feeders for the regional system. They assume also that highway planning for the Bay Area will be complementary to functions of the rapid transit system. The estimates are based on the further assumption that automobile tolls on the Bay Bridge will not be reduced to an extent which would prejudice significantly the relative attraction of rapid transit in comparison with the automobile.

The importance of continuing and improved coordination among all forms of transportation in planning, design, construction, and operation is strongly emphasized in the engineering, economic, and financial reports submitted to the District. The District's efforts have been devoted strongly toward developing and improving needed coordination among all Bay Area transportation agencies.

The District's engineers have prepared a detailed estimate of system revenues based on projected future passenger volumes and fares applicable to each station-to-station movement. Advertising and concession income is estimated at one per cent of annual fare revenue for the entire system.

Annual operating expenses of the system were also estimated by the District's engineers. Because the proposed system represents a significant departure from any existing transit system, detailed analyses were made for each individual element of system costs. Largest single category of operating expense is power, including charges for electric power and the costs of maintenance and operation of the District's power system.

Pre-operating expenses were estimated for limited periods preceding the opening of each major segment of the system. These expenses include amounts necessary for planning, recruitment, training, and other preparations which must be made prior to opening revenue service. A total of $7 million of general obligation bond money is set aside for these pre-operating expenses. The system will be in partial operation during 1966/67 and 1967/68, during which time expenses will be met from system revenues and the pre-operating allowance. No net revenue is anticipated during these years for the purpose of paying debt service on rolling equipment.

Page 20 presents estimates summarized from the engineering report on annual passenger trips, gross fare and concession revenue, and operating and pre-operating expenses for each fiscal year from 1968/69 through 1980/81.

'During peak hours, headways between trains of as little as 90 seconds . . . off-peak service as frequent as every 15 minutes.'

SURFACE STATION, BURLINGAME

TRANSPORTATION AND ECONOMIC BENEFITS OF THE RAPID TRANSIT SYSTEM

Addition of a regional rapid transit system to the Bay Area transportation network will serve to reduce traffic congestion on major highways. It will affect significantly travel habits of Bay Area residents and thus the area-wide travel pattern. These effects have been examined by the District's consultants and measurable and intangible economic benefits of transit identified.

The principal features of the proposed transit system which combine to distinguish it from facilities now available are:

Operating speeds capable of reducing substantially travel times throughout four Bay Area counties, especially during peak hours of travel.

Standards of passenger service and convenience exceeding anything now in service: quiet and comfortable cars with seats for all passengers, routes extending to major centers throughout the four counties, service at headways as short as 90 seconds, delivery at convenient locations in the heart of major cities, large free parking lots at conveniently located stations, and optional credit payment of fares.

Major urban centers throughout the Bay Area will be connected by a completely grade separated, double track rail network. Over this system trains will operate through major corridors of traffic demand at average speeds of up to 50 miles per hour, including station stops. Service will be provided at intervals as short as 90 seconds during peak periods of travel and as often as every 15 minutes in off-peak periods except late at night. Most trips on the system, even the longest, will be made without change of train. Station design and frequency of service will make transfers between lines quick and convenient whenever necessary.

The transit cars will be safe, comfortable, and quiet. Stations will be conveniently located with respect to passenger origins and destinations, and off-street parking space will be provided at all outlying stations. Every effort will be made by the District to coordinate local transit operations with those of the regional system.

Rapid transit fares will be designed to be directly competitive with the out-of-pocket costs of automobile travel. The charge account fare collection system will introduce additional convenience for the regular rider.

Rapid transit will serve effectively to reduce the size of the Bay Area, shrinking distances along all of the major routes. While the District has not estimated 1975 travel times without transit, studies by the District's engineers show clearly that, without rapid transit, highway deficiencies and congestion will be considerably greater than at present, even with the highway and bridge improvements now planned.

EFFECT OF RAPID TRANSIT ON BAY AREA TRAVEL PATTERNS

By 1975 large increases in population are expected throughout the District, along with even larger increases in total traffic volumes along the major traffic corridors. The total increase in traffic demand over 1959 through the corridors affected by the four-county transit system is estimated at 47 per cent compared with an expected four-county population increase of 31 percent. Traffic volumes during peak periods of travel are expected to grow even faster than population or total daily travel. The total number of persons traveling daily in the peak direction in the 3-hour evening peak is expected to increase by 56 per cent over this period.

The District's engineering and economic consultants reviewed the projected growth in traffic movement and the effect rapid transit is expected to have on the Bay Area transportation network in 1975.

The consulting engineers studied existing 1959 transit and auto travel volumes and patterns within the District to update survey data compiled in 1954 and 1947. Forecasts of future regional passenger movements to 1975 were made, using data on population, employment, auto registration, land use, travel times, and other factors.

Some pertinent transportation findings of the engineers' traffic studies are summarized in the lower table on page 28.

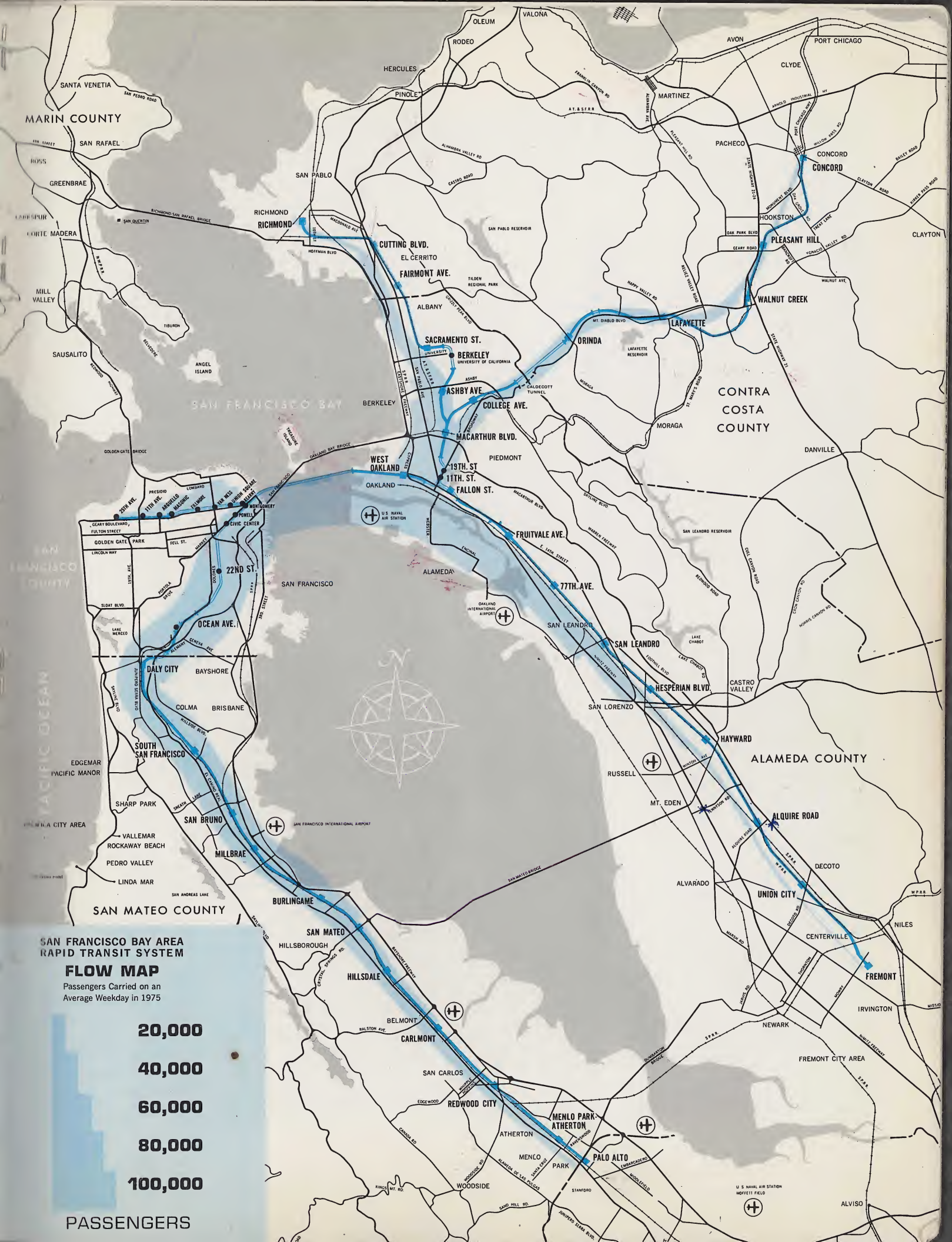
The data in the table are for the five gateways which will be affected by the four-county system and where high volumes of regional passenger movements are concentrated. It is along the corridors leading through these gateways that volumes of passenger movement regularly exceed the capacity of existing transportation facilities, resulting in heavy congestion and very substantial delay.

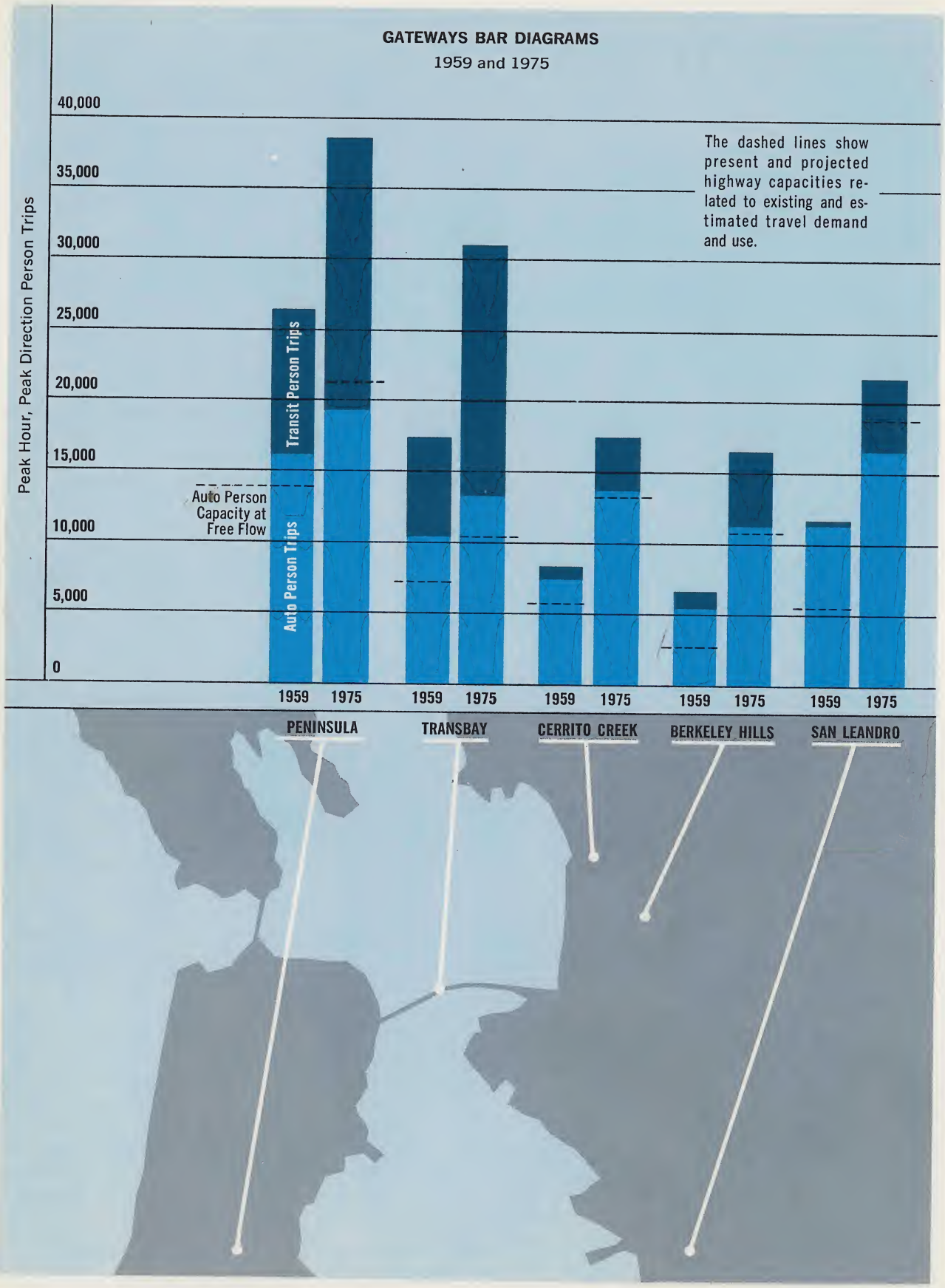
The relatively greater increase in travel throughout the Bay Area compared with population illustrates three factors: continuing population decentralization, the trend to longer home-to-work trips, and the expected increase in total regional trips.

Rapid transit is expected to carry significantly higher proportions of total movements in 1975 than does transit at present. Through the five major gateways with rapid transit, for instance, peak-hour, peak-direction volumes carried by transit will increase 160 per cent over 1959 volumes and total trips by transit over a 24-hour day will increase by 181 per cent.

Although the total number of passenger movements through these five gateways is estimated to increase by 47 per cent, the 1975 increase in number of automobile trips is only 31 per cent. The increased use of transit is also illustrated by the 1975 estimate that rapid transit will carry one of every five daily trips through the gateways compared with about one in nine by transit today, and rapid transit will carry more than 40 per cent of all 1975 peak hour, peak direction regional trips through the gateways.

The table illustrates the expected peaking of daily travel demand in 1975 during heavy-traffic hours, when congestion and delays become most serious. Rush period traffic in the non-


SAN FRANCISCO BAY AREA
RAPID TRANSIT SYSTEM
FLOW MAP
Passengers Carried on an
Average Weekday in 1975
20,000
40,000
60,000
80,000
100,000
PASSENGERS
MARIN COUNTY
SAN MATEO COUNTY
CONTRA COSTA COUNTY
ALAMEDA COUNTY
SAN FRANCISCO BAY
PACIFIC OCEAN
SAN FRANCISCO COUNTY
SANTA VENETIA
SAN RAFAEL
ROSS
GREENBRAE
CORTE MADERA
MILL VALLEY
SAUSALITO
TIBURON
ANGEL ISLAND
RICHMOND
SAN PABLO
OLEUM
VALONA
RODEO
HERCULES
PINOLE
AVON
PORT CHICAGO
CLYDE
MARTINEZ
PACHECO
CONCORD
CLAYTON
HOOKSTON
PLEASANT HILL
WALNUT CREEK
LAFAYETTE
ORINDA
MORAGA
DANVILLE
CASTRO VALLEY
CUTTING BLVD.
EL CERRITO
FAIRMONT AVE.
ALBANY
BERKELEY
UNIVERSITY OF CALIFORNIA
SACRAMENTO ST.
ASHBY AVE.
COLLEGE AVE.
MACARTHUR BLVD.
PIEDMONT
WEST OAKLAND
19TH. ST
11TH. ST.
OAKLAND
FALLON ST.
FRUITVALE AVE.
ALAMEDA
77TH. AVE.
SAN LEANDRO
HESPERIAN BLVD.
SAN LORENZO
HAYWARD
RUSSELL
MT. EDEN
ALQUIRE ROAD
DECOTO
ALVARADO
UNION CITY
NILES
CENTERVILLE
FREMONT
IRVINGTON
NEWARK
FREMONT CITY AREA
ALVISO
22ND ST.
OCEAN AVE.
DALY CITY
BAYSHORE
COLMA
BRISBANE
SOUTH SAN FRANCISCO
EDGEMAR
PACIFIC MANOR
SHARP PARK
SAN BRUNO
MILLBRAE
BURLINGAME
SAN MATEO
HILLSBOROUGH
HILLSDALE
BELMONT
CARLMONT
SAN CARLOS
REDWOOD CITY
MENLO PARK
ATHERTON
PALO ALTO
MENLO PARK
WOODSIDE
VALLEMAR
ROCKAWAY BEACH
PEDRO VALLEY
LINDA MAR
SAN FRANCISCO INTERNATIONAL AIRPORT
OAKLAND INTERNATIONAL AIRPORT
U S NAVAL AIR STATION
U S NAVAL AIR STATION MOFFETT FIELD
SAN QUENTIN
GOLDEN GATE BRIDGE
RICHMOND-SAN RAFAEL BRIDGE
OAKLAND BAY BRIDGE
SAN MATEO BRIDGE
DUMBARTON BRIDGE
TREASURE ISLAND
GOLDEN GATE PARK
CIVIC CENTER
POWELL
MONTGOMERY
EMBARCADERO
MISSION
SAN ANDREAS LAKE
LAKE MERCED
LAKE CHABOT
SAN LEANDRO RESERVOIR
SAN PABLO RESERVOIR
LAFAYETTE RESERVOIR
TILDEN REGIONAL PARK
CROCKETT
STANFORD


GATEWAYS BAR DIAGRAMS
1959 and 1975
Peak Hour, Peak Direction Person Trips
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Transit Person Trips
Auto Person Trips
Auto Person Capacity at Free Flow
The dashed lines show present and projected highway capacities related to existing and estimated travel demand and use.
1959
1975
PENINSULA
TRANSBAY
CERRITO CREEK
BERKELEY HILLS
SAN LEANDRO

peak direction is shown to increase substantially by 1975 as a result of the expected increase of employment in suburban jobs. An important factor contributing to the relative increase in peak hour travel in 1975 is the ability of rapid transit to enable people to travel at the time desired, reflecting rapid transit's ability to handle large numbers of people at times when it is most needed.

Daily passenger trips on the rapid transit system in 1975 are expected to total 377,000 in each 24-hour period, of which 56 per cent will be diverted from automobiles and 44 per cent from existing interurban and local transit facilities.

The flow map on page 25 presents the expected 24-hour transit patronage for a typical weekday in 1975, and page 26 shows expected peak hour, peak direction travel changes.

The diversion from automobiles will remove about 130,000 automobile trips per day from streets and highways in 1975.

Increases in transit use will occur at all five gateways served by rapid transit. Percentages of total peak-hour, peak-direction traffic carried by transit through each gateway in 1959 and estimates for 1975 are presented on page 28. The total five-gateway increase is from 28 per cent in 1959 to 41 per cent in 1975.

A key factor underlying the need for regional rapid transit, as discussed earlier in this summary report, is the serious highway capacity deficiency now existing and the fact that even with the extensive bridge and freeway improvements planned prior to 1975, deficiencies will have become even greater in that year in the absence of rapid transit. The engineers have studied carefully the effect of the proposed rapid transit system on the highway capacity deficiency for the six Bay Area gateways. The table on page 29 summarizes estimates of existing deficiencies (based on actual 1959 data) and the projected 1975 deficiencies with and without rapid transit.

Gateway deficiency data for the Golden Gate are shown but no reduction in deficiencies is assumed for this gateway as a result of rapid transit since the four-county plan provides no service across the Golden Gate.

The figures demonstrate that deficiencies will be virtually eliminated at four of the gateways and for the Trans-Bay gateway transit will maintain about the present level of highway deficiencies rather than allow nearly intolerable conditions to develop. The engineers believe rapid transit patronage is likely to exceed the estimates presented in the engineering report, thus serving to reduce further or eliminate completely these remaining gateway deficiencies. The large number of people now delayed by regional highway congestion will become much greater in future years in the absence of rapid transit.

ECONOMIC BENEFITS

Ebasco Services Incorporated, the District's economic consultant, was directed to look at the Bay Area in 1975 with and without the proposed rapid transit system and develop estimates of the benefits to accrue from construction and operation of the proposed network. Additional data and analyses have been prepared by the staff of the District. Economic benefits include those to which measurable dollar values can be assigned and those for which dollar values or other quantitative measures cannot readily be computed.

The evaluation of transit system benefits by the District's economic consultants was based on detailed studies and analyses of a five-county system plan prior to final determination of all transit routes. The five-county transit system evaluated by the consultants differed in some details from the plan actually adopted but embodied all of the basic concepts of the engineering report. The economic consultants estimate that net measurable economic benefits for the five-county system would amount to $42,180,000 annually by the year 1975, expressed in 1960 dollars. This represents the value of time saved by the 1975 population of the District in travel, plus direct savings in automobile operating expenses, automobile insurance and accident costs, and other costs connected with the use of private automobiles and present transit systems.

The District staff estimates the net annual measurable benefits from the four-county system in 1975 at $39,700,000 on a comparable basis. The table on page 30 presents a summary of measurable benefits estimated for the five-county system by Ebasco Services Incorporated and benefits for the four-county system based on adjustments by the District staff.

Benefits were measured by projecting traffic volumes to 1975 and then comparing the cost of transporting those volumes of people by two different systems. The two systems compared were: 1) the proposed expanded 1975 Bay Area freeway network plus existing mass transit facilities, and 2) the same 1975 system of freeways

PEAK PERIOD, THE NIMITZ FREEWAY

PERCENTAGES OF PEAK HOUR, PEAK DIRECTION TRAFFIC CARRIED BY TRANSIT THROUGH MAJOR GATEWAYS 1959 AND 1975

	Actual 1959	Estimated 1975 With Rapid Transit
Trans-Bay	40.1%	56.3%
Colma-Bayshore	38.6	49.9
Berkeley Hills	20.4	33.3
San Lorenzo-San Leandro	2.2	23.6
Cerrito Creek	11.0	21.7
Five-Gateway Total	27.8%	40.7%

Source: Parsons Brinckerhoff-Tudor-Bechtel

POPULATION, EMPLOYMENT AND PASSENGER MOVEMENTS FOUR BAY AREA COUNTIES 1959 and 1975

	Existing 1959	Projected 1975 With Rapid Transit	Per Cent Increase
TRAFFIC GENERATORS†			
Four-county population	2,502,000	3,281,000	31
Number of automobiles	1,006,300	1,480,000	47
Employment	989,000	1,291,000	31
Intercounty commuters	148,000	202,000	37
WEEKDAY REGIONAL PASSENGER TRIPS THROUGH FIVE MAJOR GATEWAYS TO BE SERVED BY RAPID TRANSIT*			
24-hour 2-way total	802,100	1,181,400	47
via transit	87,900	247,300	181
per cent transit	11	21	
via automobile	714,200	934,100	31
number of automobile trips	435,200	568,900	31
3-hour 2-way peak total (4-7 p.m.)	219,200	336,000	53
via transit	33,100	88,400	167
per cent transit	15	26	
via automobile	186,100	247,600	33
3-hour 1-way peak total (4-7 p.m.)	149,300	232,700	56
via transit	29,100	77,300	166
per cent transit	19	33	
via automobile	120,200	155,400	29
number of automobile trips	69,900	89,800	28
1-hour 1-way peak total (p.m. peak)	71,000	125,900	77
via transit	19,700	51,300	160
per cent transit	28	41	
via automobile	51,300	74,600	45
number of automobile trips	29,800	43,100	45

†1960 data.

*Data are for regional interurban trips of five miles or more in length passing through the following gateways: San Francisco-Oakland Bay Bridge, Cerrito Creek on the Alameda-Contra Costa County Line, the Caldecott Tunnel in the Berkeley Hills, a line through San Lorenzo and San Leandro from the Bay to the hills, and a line across the Peninsula between Daly City and Bayshore. At the Bay Bridge and Berkeley Hills gateways total traffic volume is included. At the other three gateways interurban passengers constitute 70 to 90 per cent of total volumes using these routes. Source: Parsons Brinckerhoff-Tudor-Bechtel

PEAK HOUR, PEAK DIRECTION INTERURBAN HIGHWAY DEFICIENCIES AT FIVE AFFECTED GATEWAYS IN 1959 AND 1975 EXPRESSED IN PERSONS PER HOUR

Gateway	1959	Estimated 1975 Without Rapid Transit	Estimated 1975 With Rapid Transit
Trans-Bay	3,250	13,700	3,000
Peninsula	2,550	7,600	(surplus)
San Leandro	6,350	2,800	(surplus)
Berkeley Hills	2,450	4,400	300
Cerrito Creek	1,650	3,200	300
Total	16,250	31,700	3,600
Golden Gate	950	6,600	6,600*

* No rapid transit through this gateway.

Source: Parsons Brinckerhoff-Tudor-Bechtel

plus the proposed District rapid transit system.

The $39,700,000 in measurable benefits shown in the table plus the non-measurable benefits discussed below are the values the people of the District will be asked to measure against the annual property taxes necessary to retire the bonds sold for construction of the system.

Measurable benefits are derived from two principal sources: savings in travel times and savings resulting from a reduction in vehicle miles traveled by automobiles. Travel time savings are based on 250 working days per year and computed for two three-hour peak periods daily at principal gateways because rapid transit would reduce congestion at these points and times sufficiently to produce measurable increases in speed and savings in time. The District's consultants estimate that the addition of rapid transit to the Bay Area transportation network will result in average saving of 15 minutes for each passenger trip through major gateways in the morning and afternoon peak periods. These savings accrue to automobile travelers as well as transit riders because of the number of persons diverted from the highway. Without rapid transit, congestion on freeways would not permit automobile traffic to move at maximum legal speeds through the principal gateways.

The value of the combined savings for all gateways except the Golden Gate is computed by the District at $26,400,000 per year.

The same 15-minute time saving per trip will apply to the daily truck trips through gateways in peak hours during 1975, for savings valued by the District at $2,500,000 per year.

Other categories of measurable benefits are those based on a reduction in automotive vehicle-miles traveled because of trips diverted to rapid transit. For the four-county network the District's engineers estimate a reduction of 472,300,000 vehicle-miles in 1975 below that which would be traveled without transit.

The economic consultants estimate out-of-pocket costs of automobile operation at 5.1 cents per mile, resulting in savings estimated by the District at $24,100,000 per year.

At the prevailing observed rates there are 0.53 reportable death and personal injury accidents per million miles of freeway travel and the average cost is $4,054. The savings in accident costs resulting from a reduction in vehicle-miles are $1,000,000 per year.

The economic consultants point out that there are significant, unmeasurable human elements in the cost of accidents and that reduction in accidents means reduction in loss of life, costly but difficult to express in dollars.

Availability of rapid transit in the four counties would reduce the number of automobiles used for commuting by an estimated 55,900. The average reduction in insurance rates for these cars is estimated at $33 each per year for total insurance savings of $1,800,000 per year.

The weighted average daily parking charge in San Francisco, Oakland, and Berkeley is determined as 79 cents for automobiles making trips which might be diverted to transit. Fewer cars will be required to park if trips are diverted to rapid transit, and the 1975 saving is estimated at $5,500,000 per year.

'Rapid transit would reduce the number of automobiles used for commuting. Fewer cars will be required to park

An estimated 33,700 daily vehicle trips across the Bay Bridge are to be diverted to rapid transit. At present tolls, this is a savings of $2,100,000.

Annual savings in traffic control costs are estimated at $400,000 based on the reduction in the number of State Highway Patrol officers below that which would be required on the freeway system with the higher volumes which would be present without rapid transit diversions. Additional savings are likely to be experienced on city streets.

The rapid transit system would replace certain arterial segments of existing transit routes, and the fares now paid on these segments, $15,800,000 annually, would not be paid if the transit system were in operation.

Fares to be paid by patrons of the regional system should be offset against the computed benefit. The engineers' 1975 fare revenue corresponding to the listed benefits is $39,900,000, and this amount is deducted in the table to indicate net benefits.

The allowances for savings in

ECONOMIC BENEFITS SUMMARY
ESTIMATED MEASURABLE BENEFITS AND COSTS IN 1975
BAY AREA RAPID TRANSIT SYSTEM

	Five-County System (1)	Four-County System (2)
Time Savings		
Person trips	$30,526,000	$26,400,000
Motor freight movement	2,875,000	2,500,000
Reductions in costs from diversion of traffic to rapid transit		
Accidents	1,172,000	1,000,000
Insurance premiums	2,104,000	1,800,000
Automobile operation	27,785,000	24,100,000
Parking charges	6,295,000	5,500,000
Bridge tolls	2,846,000	2,100,000
Traffic control	457,000	400,000
Present transit systems	19,270,000	15.800,000
Total savings in time and expenses	$93,330,000	$79,600,000
Deduct rapid transit fares	51,150,000	39,900,000
Net measurable transportation benefits in 1975	$42,180,000	$39,700,000

All values expressed in 1960 dollars.

(1) Ebasco Services Incorporated. The system studied by the economic consultants was somewhat more extensive than that described in the June 1961 engineering report.

(2) District estimates based on adjustment of data in five-county analysis by economic consultants.

automobile operating costs do not include depreciation, taking into account only out-of-pocket cost. The transit fares, deducted in determining net benefits, are applied not only to the cost of operation and maintenance but also to the purchase of equipment. Net total benefits would be higher if only rapid transit operating expenses, instead of fares, were deducted.

The analysis by the District staff indicates that the four-county system will produce more than 94 per cent of the annual net measurable benefits attributed to the more extensive five-county system studied in detail by the economic consultants.

ADDITIONAL BENEFITS

Many of the most important benefits of the regional rapid transit system are not subject to precise measurement and expression in dollars. The District's economic consultants identified many of these benefits but could not evaluate them quantitatively although pointing out their validity and importance to the Bay Area.

Time savings such as shown in the table of measurable benefits are extremely difficult to measure. Savings in travel time were computed on a basis of 1.53 cents per minute (92 cents per hour). Time may be worth considerably more to some travelers, while others may regard such savings as marginal and impossible to earn or save in monetary terms.

The estimated daily diversion of about 130,000 automobile trips from regional trafficways and local thoroughfares may result in additional time savings in cities where congestion would otherwise occur. The savings in time and effort to be made possible by the availability of rapid transit should permit Bay Area residents to make trips which they might otherwise not make because of congestion and delay. Many of these trips will be made for educational and recreational purposes, making life more pleasant for Bay Area residents.

Some time benefits other than those in the table will result from facilities such as the upper level subway in San Francisco, which will speed San Francisco's street cars along Market Street. Peninsula grade separations serving both rapid transit and the Southern Pacific should improve circulation for vehicular traffic delayed at railroad crossings.

For many Bay Area families savings will be realized if they no longer need to own and maintain second automobiles for commuting purposes. Residents without automobiles, now seriously limited in mobility, will be able to travel easily throughout the Bay Area with rapid transit.

Among the most important of the unmeasurable benefits pointed out by the economic consultants is the greatly improved flexibility rapid transit will offer to industry, business, and the Bay Area labor force. With increasing specialization of some economic activities among centers, accompanied by further residential decentralization, workers find living close to their jobs increasingly difficult. Jobs in the central cities are increasing but population is not, indicating that employment increases are dependent on increases in number of regional commuters.

Workers will benefit from rapid transit in that it will lengthen the distances they can commute conveniently and thus increase the number of job opportunities and home locations available within a given commuting time. Larger labor pools will also be available to employers, both in central cities and in outlying areas, improving flexibility in choice of business location and operation. Ebasco found employers often are obliged to pay premium labor rates because of relative inaccessibility.

The economic consultants point out the great importance of rapid transit for emergency mass evacuation. Related benefits may also be noted in the possible use of subways as emergency shelters.

Improved transportation facilities and the resultant improvement in accessibility are believed by the economic consultants generally to have a beneficial effect on property values, but measurement of net benefits of shifts in the relative desirability of property throughout the region was found infeasible. The Bay Area's 1975 population is estimated to be larger with rapid transit than without, and the distribution of population would be different. The consultants believe generally that the rapid transit system will help greatly to generate efficient and orderly patterns of development and land use.

Rapid transit will reduce land requirements for off-street parking in downtown areas, making land available for more productive purposes. Land requirements for freeways and other streets may also be reduced. Attention is also directed to the alleviation of air pollution certain to result from a reduction in automobile usage.

An important feature of the rapid transit system is the comparative ease and low cost of expanding its capacity. The two-track system with automatic train control is capable of handling trains with 30,000 seated passengers per hour in each direction. While initial passenger volumes will not approach this figure, the District will need only to add additional cars to supply more capacity as needed. Extensions of lines will also be comparatively economical because most of the high-cost elements of the system in the central areas will already be installed and able to serve the added service territory.

The economic consultants' listing of valid and important, but unmeasurable and intangible, benefits of rapid transit contributing to improved living standards in the Bay Area is not intended to be all-inclusive. They are careful to stress the importance of these benefits and to caution against any possibility of their not being fully considered in evaluating the proposed rapid transit system.

The benefits of the transit system should be examined with careful attention to the fact that population, economic activity, and passenger miles of travel are steadily increasing. Rapid transit benefits have been evaluated as of 1975, but the system will have capacity to handle substantial increased patronage without comparable expenditures for new facilities.

Looking forward, the District's economic consultants make the following statement—

"Years beyond 1975 can be expected to show an increasingly favorable economic balance for the rapid transit system."

'The central cities are the focal point for finance, trade, commerce, and regional government activities . . . and are the base for the area's service activities.'

SUBWAY COMPLEX, MARKET STREET

CONSTRUCTION COST

The engineering report and supplement include estimates of construction costs for the regional rapid transit system, and these cost estimates are summarized in the table on page 35. Routes have been established and stations and yards located with sufficient precision to permit a satisfactory cost estimate to be made by applying typical design sections throughout the system.

The cost estimate takes into account significant physical factors such as route alignment and grade, type of construction (surface, aerial, subway, tunnel, or tube), geological conditions, foundation requirements, traffic maintenance, utility relocation, rights of way, and special problems of grade separation. Estimates are based on San Francisco Bay Area price levels and include allowances for future inflation.

The cost estimates presented here are for a completely operative system with all costs included except rolling equipment, financing charges, and administrative expenses of the District. Costs of the Trans-Bay Tube and its approaches were estimated separately because of the separate financing provisions applicable to them. Requirements for and costs of equipment were estimated separately and are presented later in this summary report.

The allowance for inflation in the cost of the basic system is $145,055,000 and for the tube and approaches is $19,908,000. These figures represent about 18 per cent of construction and land acquisition costs. The allowance for inflation was computed by reviewing cost trends in the Bay Area and the nation for major categories of work involved in the project. Increases in construction costs were developed as projections of historical cost trends through the year 1966 and continuation of that level of inflation until the project is completed. By mid-1966 about two-thirds of the cost of construction will have been spent.

The District and its engineers believe that the allowance for inflation is reasonable and proper and should be sufficient to assure completion of the system within the cost estimate presented in the engineering reports.

CONSTRUCTION SCHEDULE

Construction of the entire 103-mile regional rapid transit system and related stations, yards, and other facilities is scheduled over an eight and one-half year period. Final design and right of way acquisition are intended to start in July 1962 and actual construction in 1963. Most of the system will be in operation by 1968, and final completion is planned for the end of 1970.

Several factors are responsible for this extended period of construction, most of them related directly to the very magnitude of the undertaking. Key facilities in the system are large: the Trans-Bay Tube; downtown subway construction in San Francisco, Oakland, and Berkeley; and the tunnel through the Berkeley Hills. Construction of the tube, for instance, is estimated to require four years. The capacity of the construction industry to accommodate the volume of work

ESTIMATED CONSTRUCTION COST AND PRE-OPERATING EXPENSE

FOUR-COUNTY SYSTEM

	Basic Transit Routes	Trans-Bay Tube and Approaches
Track and structures	$309,367,000	$ 81,067,000
Stations	118,855,000	
Yards and shops	15,702,000	
Electrification	66,047,000	5,948,000
Train control	21,769,000	899,000
Utility relocation	44,624,000	2,560,000
Engineering and charges	57,634,000	9,047,000
Right-of-way	98,596,000	1,024,000
Contingencies	73,260,000	10,055,000
Inflation	145,055,000	19,908,000
SUBTOTAL	$950,909,000	$130,508,000

DETAIL OF SYSTEM COST BY ROUTES

San Francisco Downtown	$151,654,000	
Peninsula Line (14th Street, San Francisco, to Palo Alto)	229,321,000	
Geary Line (Octavia Street, San Francisco, to 25th Avenue)	54,370,000	
Oakland Downtown	89,436,000	
Berkeley-Richmond Line (West Grand Ave., Oakland, to Richmond)	124,058,000	
Central Contra Costa Line (MacArthur Station, Oakland, to Concord)	152,113,000	
Southern Alameda County Line Fallon St., Oakland, to Fremont)	127,503,000	
	$928,455,000	
Trans-Bay Line		
San Francisco Approach		$ 26,609,000
Subaqueous Tube		90,591,000
Oakland Approach		13,308,000
Central Yard, Shops, and Administration	22,454,000	
SUBTOTAL	$950,909,000	
Deduct Participation by others*	20,235,000	
NET CONSTRUCTION COST	$930,674,000	
Pre-operating expense	7,000,000	
TOTAL COST	$937,674,000	$130,508,000

* State and railroad participation in costs of grade separations.

involved without creating shortages of labor and materials is a factor limiting the speed with which the project should proceed.

The District's ability to sell bonds is limited since outstanding bonded debt cannot by law exceed 15 per cent of the District's assessed valuation. The recommended bond authorization of $939,000,000 represents almost 20 percent of the 1961/62 four-county valuation of $4,783,460,255 so an increase in total valuation to about $6.3 billion by the end of the construction period is necessary to permit sale of the entire recommended amount. The District is growing and, using what is considered a very conservative projection of future valuation, estimated bonding capacity will be adequate to permit the system to be financed within the 8½-year construction period recommended by the District engineers.

The scheduled drawdown of funds is outlined in the discussion of project financing along with a conservative projection of future District bonding capacity, excluding Marin County.

The construction program has been developed to coordinate various items of work in order to bring operable sections of the system into service as soon as possible. Right of way acquisition for the entire system is planned to proceed as rapidly as possible so that availability will be assured by the time actual construction starts and also to avoid future increases in land costs which are likely to develop as system construction gets under way. Time must be allowed in the schedule for final design and preparation of detailed plans and specifications.

ESTIMATED SCHEDULE OF EQUIPMENT ORDER AND DELIVERY REQUIREMENTS

Number of Cars	Estimated Cost	Order Date (July 1)	Delivery Date (January 1)	Date Placed In Service (July 1)
10	$ 1,500,000	1963*	1965**	1966
40	6,000,000	1963	1966	1966
450	69,750,000	1964	1967	1967
120	19,200,000	1965	1968	1968
70	11,200,000	1966	1969	1969
40	6,400,000	1967	1970	1970
40	6,400,000	1968	1971	1971
20	3,200,000	1969	1972	1972
10	1,600,000	1970	1973	1973
10	1,600,000	1971	1974	1974
10	1,600,000	1972	1975	1975
10	1,600,000	1973	1976	1976
10	1,600,000	1974	1977	1977
10	1,600,000	1975	1978	1978
10	1,600,000	1976	1979	1979
10	1,600,000	1977	1980	1980
870	$136,450,000			

*January 1
**July 1

The following are some of the key dates in the construction schedule:

JULY 1, 1962: Final design and land acquisition begin.

JULY 1, 1963: Construction begins on Trans-Bay Tube.

JANUARY 1, 1964: Actual construction begins on other system elements.

DURING 1966: First trains in service.

JULY 1, 1967: Trans-Bay Tube completed.

JULY 1, 1968: Three-fourths of system mileage in service. Service provided on the Trans-Bay connection between San Francisco and Oakland, from Oakland to Richmond, Orinda, and Hayward; from San Francisco to Palo Alto, and from downtown San Francisco to 25th Avenue and Geary Boulevard.

DECEMBER 31, 1970: Full four-county system complete and in operation. Service will be extended to Concord on the Central Contra Costa Line and Fremont on the Southern Alameda County Line.

Segments of the system will be placed in service as operable units are completed. Early completion of a section is considered important since this section will be available for testing equipment, including the control system, and for training personnel before the rest of the system is ready for service.

The engineers estimate that 870 transit cars must be purchased by 1980, with most of the equipment to be purchased during the time the transit system is under construction. The tabulation above presents the estimated schedule of equipment requirements, coordinated with the construction schedule in order to make transit cars available as successive sections of the system are completed.

'A two-level subway is proposed for downtown Oakland to facilitate junction among the four lines converging there. Continuous pedestrian mezzanines are proposed . . .'

SUBWAY COMPLEX, BROADWAY

THE FINANCIAL PLAN

The District Financial Plan provides for the regional rapid transit system to be financed from three principal sources:

1. Fixed elements of the system, exclusive of the Trans-Bay Tube and its approaches, are to be financed by District general obligation bonds. A bond authorization of $939,000,000 is recommended, with interest during construction to be paid from taxation.

2. Transit cars are to be financed by revenue bonds payable from gross revenues of transit system operations. The Financial Plan provides for $131,750,000 of District revenue bonds.

3. The Trans-Bay Tube and its approaches are to be financed by the California Toll Bridge Authority. The actual terms and conditions of the bonds will be established by the Authority. The District's financial report suggests a logical approach which might be followed in issuing these bonds. Part of the estimated cost of $130,508,000 is to be obtained from sale of Authority revenue bonds, secured by revenues of the San Francisco-Oakland Bay Bridge and the San Mateo-Hayward and Dumbarton Bridges. Sale of $113,750,000 of bonds is contemplated, with the balance obtained from bridge revenues applied to construction. The District would reimburse the Authority for the cost of tube approaches but not for the tube itself. The actual schedule of reimbursements is subject to negotiation between the Authority and the District. Construction cost of the approaches is estimated at $39,917,000. Including interest and other charges, the reimbursable amount is estimated to total $58,484,250.

Implementation of the Financial Plan requires authorization of general obligation bonds by affirmative vote of at least 60 per cent of the District electors voting at an election. The District is empowered by law to issue revenue bonds for equipment by resolution of its Board of Directors if general obligation bonds have previously been authorized for the system at an election. The Toll Bridge Authority may sell revenue bonds for tube construction at any time if at least $500,000,000 of District general obligation bonds have been authorized prior to November 30, 1963. Authority action requires no popular vote or further authorization by the Legislature. All other financing is therefore dependent on voter approval of general obligation bonds.

COSTS TO BE PAID FROM GENERAL OBLIGATION BONDS

Construction cost for basic four-county system	$937,674,000
Expenses incidental to project and issuance of bonds	920,982
Reimbursement of State for Rapid Transit Commission expense	405,018
Total general obligation bond issue	$939,000,000

GENERAL OBLIGATION BONDS

Basic fixed elements of the regional rapid transit system are to be financed by general obligation bonds of the District. Authorization of a principal amount of $939,000,000 of bonds is recommended in order to provide necessary funds for the system.

The principal amount of $939,000,000 is believed necessary in order to provide sufficient funds for construction and allow for estimated inflation, to pay certain costs incidental to the project and to the issuance of bonds, and to repay the State of California for funds advanced for studies to the Bay Area Rapid Transit Commission, the District's predecessor. These costs are summarized on page 38.

General obligation bonds are to be secured by the full faith and credit of the District, including the power to tax, and, to the extent revenues are not available from operations or other sources, interest and principal will be paid from taxes levied on property in the District.

Sale of general obligation bonds in series over a period of years is recommended. The District Financial Plan, which is a general guide and indication as to the pattern of bond sales and maturity schedules which can be expected, provides for sale of bonds over a period of seven and one-half years. A total of 18 sales is suggested, with bonds being offered as funds are needed under the construction schedule. The financial consultants recommend that bonds be offered not more often than four times in any year.

On the basis of the construction schedule, a schedule of general obligation bond sales has been established which will provide construction funds as needed and still stay within the District's statutory debt limit. A conservative projection of future District assessed valuation is used in estimating bonding capacity, and the schedule of sales is established so as to hold the total amount outstanding below the legal debt limit.

Need for construction funds, schedules for bond sales, and estimated bonding capacity are summarized in the table on page 40.

If the District assessed valuation grows more rapidly than provided for in the plan, the District might be able to accelerate its construction and borrowing schedule. Ability to speed up the program would be limited under these circumstances by the ability of the bond market to absorb more District bonds in a shorter period of time and of the construction industry to undertake additional work or speed up elements of the project without unduly increasing total cost.

General obligation bonds represent the least expensive means by which the District can borrow the large amounts needed to complete the system. The financial consultants estimate an overall interest rate of 4 per cent per annum.

As outlined in the Financial Plan, the general obligation bonds will be serial bonds, maturing in specified amounts in specified years. The schedule of maturities will be established for each series of bonds at the time that series is offered for sale and the actual rates of interest set by competitive bidding. The schedules presented in the Financial Plan are tentative but demonstrate how the required amount of bonds may be sold and paid off within the limits of certain policies established by the District's Board of Directors. Temporary borrowing may be used to avoid the need to sell bonds in a poor market, when higher interest rates would be necessary.

Some of the salient features of the proposed general obligation bonds are discussed below. Within the limits of its adopted policies, bond sales and scheduled maturities can be adjusted to the extent required or permitted by the construction schedule and conditions in the municipal bond market.

1. Bonds are sold in series as funds are needed for the construction program. Sales are not held more often than once every four months.

2. Principal payments are to begin for all series of bonds on July 1, 1972, eighteen months after the estimated date of completion of the system, and continue until 1999, when all bonds will have matured and been paid. Many bonds can be made callable so that the District can pay them off before maturity if desired or can refund them if better interest rates are available in the future.

3. Interest during the construction period is not to be capitalized but is to be paid out of taxes levied by the District. Payment of interest during construction out of bond funds was a possibility considered but rejected by the consultants and the District Board.

To have included interest during construction would have required substantial increases in the principal amounts of bonds, necessitated lengthening the construction period because of the District's bonding limit, and increased annual interest and principal requirements for the years following completion of the system.

ANNUAL FUND REQUIREMENTS AND SCHEDULE OF GENERAL OBLIGATION BOND SALES FOUR-COUNTY SYSTEM

Fiscal Year	Annual Construction Requirements	General Obligation Bond Sales		Annual Total Bond Sales*	Cumulative Amount of Bonds Outstanding End of Year	Estimated Bonding Capacity
1962/63	$ 38,000,000	Sept. 1	$ 43,000,000**	$ 43,000,000	$ 43,000,000	$748,050,000
1963/64	101,000,000	July 1	40,000,000			
		Jan. 1	65,000,000			
		May 1	60,000,000**	165,000,000	208,000,000	780,000,000
1964/65	219,000,000	Sept. 1	65,000,000			
		Jan. 1	100,000,000			
		May 1	80,000,000	245,000,000	453,000,000	811,800,000
1965/66	260,000,000	Sept. 1	80,000,000			
		Jan. 1	86,000,000**			
		May 1	50,000,000	216,000,000	669,000,000	843,750,000
1966/67	159,000,000	Sept. 1	50,000,000			
		Jan. 1	60,000,000			
		May 1	25,000,000	135,000,000	804,000,000	875,700,000
1967/68	86,000,000	Sept. 1	25,000,000			
		Jan. 1	35,000,000			
		May 1	40,000,000	100,000,000	904,000,000	907,650,000
1968/69	39,000,000	June 1	20,000,000	20,000,000	924,000,000	939,450,000
1969/70	26,000,000	Mar. 1	15,000,000	15,000,000	939,000,000	971,250,000
1970/71	9,674,000					

*All bonds mature serially 1972-1999, inclusive.

**$4,000,000 of the 1962 sale and $10,000,000 of the 1964 sales are to be used for equipment purchases. The general obligation bond fund will be reimbursed from revenue bonds in 1966.

4. Principal matures for each series each year from 1972 through 1999. The maturity schedule suggested in the Financial Plan provides for gradually increasing annual total bond service requirements (principal plus interest) from 1971/72 to 1990/91 and equal annual total requirements thereafter until all bonds are paid off. In establishing this gradually increasing schedule of debt service payments the Board determined that bond service requirements should increase gradually in accordance with a very conservative projection of future assessed valuation of the four counties containing transit facilities. This plan provides assurance against the total tax rate for bond service exceeding 67 cents per $100 in any year, and as will be discussed later in this summary report, the actual tax rate is not expected to exceed 63 cents. It will be approximately constant from 1971/72 to 1974/75 and will decline thereafter. The maturity schedule is based on an assumed interest rate of 4 per cent and the term of the bonds may be shortened or extended on the basis of actual interest rates.

All tax rate computations assume no participation in the project by Marin County.

Several factors may make it possible for the District to sell less than the total authorized amount of $939,000,000 of general obligation bonds. The cost estimate includes liberal allowances for contingencies and inflation, together accounting for almost one-quarter of the total principal amount. If costs do not rise as sharply as allowed for or if fewer contingent costs are present, the amount of bonds sold by the District can be reduced, with resultant reductions in the costs to taxpayers.

The District program is not dependent on the present or future availability of federal aid for rapid transit. If such aid becomes available, as grants or loans, the District will very probably be able to realize substantial savings in overall project costs.

Possible opportunities for assistance in financing may be found in the Housing Act of 1961 and other federal legislation. The present law contains some provisions for loans and grants for public transportation, and larger amounts will probably be available in future years. Any federal grant to the District will, of course, reduce the required amount of bonds. Federal loans will also be of assistance since financing costs will very probably be lower if money is borrowed from the government.

THE TRANS-BAY TUBE

'The trip between Montgomery Street in San Francisco and Eleventh Street in Oakland will require only eight minutes. Tube and approaches are to be financed by the California Toll Bridge Authority.'

FINANCING PURCHASE OF ROLLING EQUIPMENT

The regional rapid transit system will require a total of 870 modern transit cars by mid-1980, according to the estimates of the District's engineers. Cars are estimated to cost between $150,000 and $160,000 each. Delivery of 500 cars will be required by January 1, 1967, and an additional 230 cars will be needed before the end of the construction period in 1970. Most of the rolling equipment, therefore, will be needed before the end of the construction period and many progress payments made before any sizable portion of the transit network is in service. If the full authorized amount of general obligation bonds is not actually needed in construction of the basic system, some equipment payments may be made from this source. Savings in interest might thus be realized. Operating revenues could still be applied to payment of interest and principal so that no taxes would be levied to pay the costs of equipment. The Financial Plan does not provide for greater use of general obligation bond money to finance this equipment, largely because of limited District bonding capacity but also because another suitable financing method is available.

The Financial Plan recommends that rolling equipment needed before completion of the system be financed by revenue bonds of the District, issued by resolution of the Board pursuant to the District Act and the Revenue Bond Law of 1941. Bonds would be secured by a pledge of

EQUIPMENT PROGRESS PAYMENTS AND REVENUE BOND SALES
(in thousands)

Calendar Year	Equipment Progress Payments	Cost Financed From Bonds	Revenue Bonds Sold
1963	$ 750	$	$
1964	7,575		
1965	5,070		
1966	32,020	45,415	51,650(a)(b)
1967	43,195	43,195	46,625(b)
1968	14,720	14,720	15,100(b)
1969	8,480	8,480	8,500
1970	5,920	5,920	5,925
1971	4,640	3,941	3,950
1972-1980	14,080	0	0
	$136,450	$121,671	$131,750

(a) Includes $14,000,000 to reimburse general obligation bond fund for advances in 1962 and 1964 for equipment progress payments required to be made prior to 1966.

(b) Includes capitalized interest to July 1, 1968.

ANNUAL REQUIREMENTS FOR REVENUE BOND INTEREST AND PRINCIPAL AND SYSTEM GROSS OPERATING REVENUES
(in thousands)

Fiscal Year	REVENUE BOND SERVICE REQUIREMENTS			Gross Operating Revenues
	Principal	Interest	Total	
1968/69	$	$5,587*	$ 5,587	$29,259
1969/70		5,930	5,930	33,596
1970/71		6,164	6,164	35,950
1971/72		6,258	6,258	37,607
1972/73	5,976	6,258	12,234	38,804
1973/74	6,260	5,974	12,234	39,415
1974/75	6,558	5,677	12,235	39,883
1975/76	6,869	5,365	12,234	40,293
1976/77	7,196	5,039	12,235	40,712
1977/78	7,537	4,697	12,234	41,104
1978/79	7,895	4,339	12,234	41,522
1979/80	8,270	3,964	12,234	41,912
1980/81	8,663	3,571	12,234**	42,309

*All interest to and including July 1, 1968, is to be paid from bond proceeds.
**Total bond service requirements remain at about this level through 1986/87, then decline until the last bonds are retired in 1990/91.

FUND REQUIREMENTS AND SUGGESTED REVENUE BOND SALES FOR TRANS-BAY TUBE AND APPROACHES

Fiscal Year	Construction Requirements	Revenue Bonds Sold*	Estimated Net Bridge Revenues Available for Construction**
1962/63	$ 4,000,000	$ 42,500,000	$
1963/64	15,000,000		
1964/65	43,000,000	71,250,000	8,632,000
1965/66	44,000,000		7,070,000
1966/67	24,508,000		7,070,000
	$130,508,000	$113,750,000	$22,772,000

*Bond proceeds are to be used for interest during construction and incidental expenses as well as for construction.
**The financial report assumes that a total of $20,000,000 will be applied to construction from bridge revenues.

gross revenues of the transit system and paid for entirely from fare income. Revenue bond interest and principal would have first lien on operating revenues.

The table on page 42 shows annual revenue bond sales by years and their relation to the schedule of equipment progress payments. The progress payments are based on equipment order, delivery, and payment requirements outlined below.

The engineers believe that a suitable method of paying the manufacturer for transit cars is 10 per cent at the time the order is placed, 40 per cent midway between order date and delivery date, and the final 50 per cent on delivery, except for certain retentions until final acceptance. Construction is generally expected to require 2½ years from the date of the order.

The first cars are to be ordered in January 1963 for July 1965 delivery. Additional cars would be ordered each year.

Under the Financial Plan the first revenue bonds are to be offered for sale about January 1, 1966. This first sale is deferred as long as possible so that it will take place after most major elements of the system, including the Trans-Bay Tube, are under contract. The buyer of revenue bonds should be assured at the time he buys the bonds that a revenue-producing transit system is under construction and that basic elements will be completed on schedule. About $14 million is to be advanced from the general obligation bonds for equipment purchases and paid back from the first revenue bond sale.

Annual sales of revenue bonds are proposed each year from 1966 to 1971. Interest would be paid from bond proceeds up until July 1968 and out of revenues

beginning in the 1968/69 fiscal year. The first principal would mature in 1973.

As indicated in the table, a total of $131,750,000 of revenue bonds will be issued over a five-year period, $121,671,000 applied directly to purchase of equipment and the balance of $10,079,000 used for capitalized interest and incidental expenses of the financing. Some adjustment in the principal amount, distribution of proceeds, or timing of sales may, of course, be necessary or desirable.

After the system is complete and in full operation, rolling equipment is to be purchased out of operating revenues of the system, with no issuance of revenue bonds after January 1, 1971.

All revenue bonds are proposed to mature within about twenty years from date of sale, and maturity schedules are assumed to provide for approximately equal annual payments of interest plus principal each year beginning in 1972/73. The financial consultants estimate that District revenue bonds will have an overall interest rate of 4¾ per cent per annum. The upper table on page 43 shows the estimated annual bond service requirements for the revenue bonds, indicating average total interest and principal requirements of about $12,234,000 per year over most of the period bonds are outstanding. Estimated gross revenues, which are pledged to the bonds, are also shown.

Estimated operating revenues are clearly sufficient to pay revenue bond interest and principal, amounting to more than three times bond service requirements in each year.

'Savings in time and effort by rapid transit should permit Bay Area residents to make trips which they might otherwise not make because of congestion and delay.'

TRANS-BAY TUBE FINANCING

The Trans-Bay Tube connecting San Francisco and Oakland, and its approaches, are to be financed by the California Toll Bridge Authority. Special legislation enacted in 1959 permits the Authority to sell revenue bonds for this purpose and to pledge net revenues of the San Francisco-Oakland Bay Bridge, the San Mateo-Hayward Bridge, and the Dumbarton Bridge as security for the payment of principal and interest.

The financial report emphasizes that final decisions on tube financing are to be made by the Authority and that the District report presents a reasonable but not definitive approach to this revenue bond financing. The suggested provisions were discussed with appropriate officials of the State Department of Public Works. An analysis of tube financing is included in the District's financial report in order to demonstrate that revenue bond financing by the Authority is feasible and to develop a reasonable schedule for reimbursement of the costs of approaches.

The District engineers estimate that the tube and its approaches will cost $130,508,000. Net revenues of the bridges are currently committed to other purposes, including reconstruction of the Bay Bridge and construction of a new San Mateo-Hayward bridge. No revenues are expected to be available from the bridges for transit purposes until July 1, 1964.

The Financial Plan suggests that the Toll Bridge Authority sell $113,750,000 of revenue bonds: $42,500,000 on July 1, 1962, and another $71,250,000

on January 1, 1965. The financial consultants estimate that $20,000,000 of the total construction cost will be paid from bridge revenues received during 1964/65, 1965/66, and 1966/67. The annual need for construction funds, the bond sale schedule, and the availability of bridge revenues for construction are summarized in the lower table on page 43. The available funds from bond sales and bridge revenues exceed construction requirements over the period shown because some interest will be paid from bonds.

The bond maturity schedule suggested by the District's financial consultants provides for retiring the Toll Bridge Authority revenue bonds over a twenty-year period ending in 1987, with approximately equal payments of interest plus principal amounting to about $8,556,250. Future net revenues of the bridges are estimated at an average of $12,750,000 annually, providing coverage of about 1.50 times annual interest and principal requirements for this twenty-year schedule. The outstanding earnings record of the bridges offers assurance that Toll Bridge Authority revenue bonds issued under these terms will be readily salable. The Authority will not be dependent on revenues of the transit system in order to meet its bond service requirements. Interest and principal will be paid from bridge tolls.

Although the Transit District will not pay for the tube itself nor pledge its revenues to payment of the Authority revenue bonds, the District will repay the Authority for costs of the approaches to the tube.

The enabling legislation provides that terms of reimbursement are subject to negotiation between the District and the Authority. The District's financial consultants have prepared estimates of the amount and period of reimbursements for estimating total payments which may be required in future years.

The financial consultants estimate the total amount of tube approach costs subject to reimbursement at $58,484,250, which includes a proportional share of interest payable over the life of the revenue bonds. The law requires this amount to be repaid prior to the final maturity date of the Authority's bonds. Distributing the reimbursable costs evenly over a nineteen-year period ending in 1987 results in annual costs to the District of approximately $3,078,000. This amount will be paid to the Authority but the financial consultants recommend that these payments rank in priority below annual interest and principal on the District's own revenue bonds, operation and maintenance costs of the transit system, and contributions to revenue bond reserves.

PAYMENT OF SYSTEM COSTS

The Financial Plan is based on the premise that, after completion, operating revenues will pay all District costs except general obligation bond interest and principal. The engineering and financial reports indicate clearly that operating revenues will be sufficient to pay all costs of equipment and of system operation and maintenance. The following table shows primary sources of payment for each element of system costs.

Revenues will be sufficient to pay all costs of rolling equipment, operation and maintenance, and reimbursement of the Toll Bridge Authority for the costs of tube approaches beginning in 1968/69. Beginning in 1970/71, revenues will also be applied directly to the purchase of equipment. No taxes will need to be levied by the District after the system is complete except for payment of general obligation bond service.

The table at the top of page 46 is condensed from the financial report and shows the application of estimated system revenues to various purposes.

Annual Cost Item	Source of Payment
General obligation bond interest and principal	Property taxes
If surplus operating revenues are available, they may be applied to this purpose.	
System operation and maintenance expenses	Operating revenues
Rolling equipment	Operating revenues
Prior to completion of the system, rolling equipment will be financed by revenue bonds, and the bonds will be paid from revenues. After completion, purchases will be made directly from available revenues.	
Trans-Bay Tube	Bridge tolls
Tube approaches	Operating revenues
Approaches will be financed by Toll Bridge Authority revenue bonds, and the Authority will be reimbursed from transit operating revenues.	

ESTIMATED APPLICATION OF TRANSIT SYSTEM REVENUES TO BOND SERVICE, OPERATION AND MAINTENANCE, AND TOLL BRIDGE AUTHORITY REIMBURSEMENT, SHOWING AVAILABLE SURPLUSES

(in thousands)

Fiscal Year	Estimated Gross Revenues	Revenue Bond Interest and Principal and Reserves	Estimated Operation and Maintenance Expenses	Assumed Reimbursement of California Toll Bridge Authority	Surplus Revenues Available for Equipment, Reserves, Other Purposes	Surplus Applied to Equipment Purchase	Surplus Available for Other District Purposes
	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
1968/69	$29,259	$ 7,896	$18,285	$3,078			
1969/70	33,596	9,692	20,127	3,078	$ 699	$ 699	
1970/71	35,950	6,351	20,421	3,078	6,100	2,400	$3,700
1971/72	37,607	6,258	21,613	3,078	6,658	1,600	5,058
1972/73	38,804	11,950	22,171	3,078	1,605	1,600	5
1973/74	39,415	11,937	22,480	3,078	1,920	1,600	320
1974/75	39,883	11,923	22,698	3,078	2,184	1,600	584
1975/76	40,293	11,908	22,894	3,078	2,413	1,600	813

Col. 1 Estimates of District's engineers.

Col. 2 Based on 20-year, 4¾% bonds with first maturity in 1972/73. From 1968/69 to 1970/71 deposits are made in a bond reserve fund. Beginning in 1972/73 withdrawals are made from the reserve fund and applied to interest and principal. Withdrawals are made because reserve requirements decline as bonds are retired.

Col. 3 Estimates of District's engineers.

Col. 4 Reimbursement for estimated cost of tube approaches. 19-year schedule.

Col. 6 See pp. 43 and 44 for discussion of equipment purchases after last sale of revenue bonds in 1970/71.

ANNUAL COSTS TO BE PAID FROM TAXATION AND PROBABLE ANNUAL TAX RATES REQUIRED

Fiscal Year	General Obligation Bonds (000's)			Administrative and General District Expense (000's)	Total Costs Paid from Taxes (000's)	Probable Total Tax Rate per $100*
	Interest	Principal	Total			
1962/63	$ 1,433		$ 1,433	$1,502	$ 2,935	6c
1963/64	5,020		5,020	1,749	6,769	13
1964/65	13,020		13,020	2,598	15,618	28
1965/66	22,840		22,840	2,471	25,311	44
1966/67	29,793		29,793	2,144	31,937	53
1967/68	33,960		33,960	2,227	36,187	58
1968/69	36,227		36,227	1,765	37,992	58
1969/70	37,160		37,160	1,544	38,704	57
1970/71	37,560		37,560	1,323	38,883	55
1971/72	37,560	$ 8,265	45,825		45,825	63
1972/73	37,229	10,107	47,336		47,336	63
1973/74	36,825	11,824	48,649		48,649	63
1974/75	36,352	13,617	49,969		49,969	63
1975/76	35,807	15,475	51,282		51,282	62
1976/77	35,188	17,414	52,602		52,602	62
1977/78	34,492	19,423	53,915		53,915	62
1978/79	33,715	21,520	55,235		55,235	62
1979/80	32,854	23,687	56,541		56,541	62
1980/81	31,907	25,954	57,861		57,861	62
1981/82	30,869	27,622	58,491		58,491	61
1982/83	29,764	29,330	59,094		59,094	61
1983/84	28,590	31,107	59,697		59,697	61
1984/85	27,346	32,954	60,300		60,300	61
1985/86	26,028	34,875	60,903		60,903	61
1986/87	24,633	36,873	61,506		61,506	61
1987/88	23,158	38,951	62,109		62,109	61
1988/89	21,600	41,112	62,712		62,712	61
1989/90	19,956	43,359	63,315		63,315	61
1990/91 to 1998/99			63,650		63,650	61**

*Based on Financial Adviser's estimate of most probable District assessed valuation through 1980/81. A modified, more conservative projection is used from 1980/81 to 1990/91.

**District assessed valuation assumed to remain constant at $10.5 billion after 1990/91.

TAXATION FOR GENERAL OBLIGATION BONDS

As the previous section shows, operating revenues will pay for many elements of system costs. Payment of general obligation bond interest and principal from taxes is considered appropriate, however, because of benefits accruing to residents and property owners. Patronage ultimately may prove to be substantially greater than estimated in the engineering report, and the standard of service is intended to be as attractive as possible to potential system patrons. If a higher level of revenues is developed, the District may be able to apply some of these revenues to the payment of general obligation bonds, thus permitting a reduction in the District tax rate, or may be able to use these revenues to finance extensions of the system.

Annual payments of serial maturities for the District's general obligation bonds begin in 1972. Total annual interest and principal requirements increase from 1971/72 to 1990/91 under the District's Financial Plan. The increase is gradual and is established so as to be certain that the resulting total tax rate will not exceed 67 cents per $100 assessed valuation in the four counties taxed for bond service. The schedule in the financial report is based on a 4 per cent interest rate. Adjustments can be made if the actual rate is higher or lower.

A study by the District's financial adviser indicates that the 67-cent maximum will not be reached because the growth of District valuation actually expected is greater than the conservative trend of future growth on which the financing plan is based. Probable maximum tax rate will be 63 cents, and a rate of 61 or 62 cents can reasonably be expected for most of the years between 1971/72 and 1990/91.

During the period of construction portions of the District's administrative and general expenses will be paid from taxation. The annual rate for these purposes is limited to 5 cents per $100 assessed valuation.

During construction, when no principal is maturing and only interest is being paid, the total District tax rate will range from 6 cents to 58 cents.

The table on page 46 shows annual bond service requirements, administrative and general expenses to be paid from taxes, and the tax rates which will result under the projection of most probable future District assessed valuation. A small annual valuation increase is assumed from 1981 to 1990 and valuation is assumed constant beginning 1990/91. Consultants expect valuation will continue to increase while bond service does not, therefore assuring a reduction in tax rate.

Assessed valuation and tax rate computations exclude Marin County, which will not be served by the four-county system.

To relate these probable tax rates to the costs to individual taxpayers within the District is difficult because of the wide range of individual assessed valuations. On the basis of the rates above each taxpayer should be able to estimate the cost of transit bonds to him in terms of annual taxes. Costs to renters will be similarly calculated if assumed to be passed on by owners.

Current indications are that the median half of all single-family residences in the five-county Bay Area are assessed at between $3,000 and $6,000, indicating market values between $12,000 and $24,000 if assessment at 25 per cent of market value is assumed.

The table below shows probable annual costs to property owners with assessed valuation in this $3,000 to $6,000 range during key periods of the construction schedule. The median assessed valuation is probably near $4,000 ($16,000 market value) and the maximum tax for this valuation is $25 per year.

The weighted average tax rate in 1960/61 for the four Bay Area counties in the transit plan was $8.67 per $100. The 63-cent rate which would be the Transit District's maximum represents 7¼ per cent of this total. The average combined tax rate for school purposes in the Bay Area was $3.63 and the weighted average county rate, excluding San Francisco because it is both city and county,

Estimated Annual Costs for Payment of Bond Interest and Principal by Typical Homeowner

(Alameda, Contra Costa, San Francisco, and San Mateo Counties)

	Tax Rate Per $100	Assessed Valuation $3000	$4000	$5000	$6000
1963/64					
Start of construction	13c	$ 4	$ 5	$ 7	$ 8
1967/68					
More than half complete	58c	17	23	29	35
Probable maximum	63c	19	25	32	38

was $2.30 per $100 assessed valuation. Combined tax rates throughout the Bay Area have shown a steady increase over a period of many years. If this trend continues in the future, the Transit District's 63-cent rate will represent an even lower percentage of the future Bay Area total tax rate.

All of these estimated tax rates and annual payments by homeowners are based on the assumption that the general obligation bonds will be supported entirely from property taxes. Based on current estimates of revenues and expenses, this assumption is safe and conservative and provides a sound basis on which to consider the costs of the transit proposal. If future net income exceeds current estimates, some of these revenues may be applied to payment of bond interest and principal, thus permitting a reduction in the District tax rate.

SUMMARY OF DATA FURNISHED PURSUANT TO PUBLIC UTILITIES CODE SECTION 29152

A. A general description of the facilities to be acquired and constructed from the proceeds of the proposed bond issue is an adequate, modern, interurban mass transit system extending through the City and County of San Francisco and southward through the County of San Mateo to the vicinity of Palo Alto in the County of Santa Clara and from San Francisco eastward to Oakland in the County of Alameda, from Oakland to the vicinity of Richmond in the County of Contra Costa, from Oakland to the vicinity of Concord in the County of Contra Costa and from Oakland to the vicinity of Fremont in the County of Alameda.

The "October 1961 Supplement to the June 1961 Engineering Report to the San Francisco Bay Area Rapid Transit District—Four-County System" together with the "Engineering Report to the San Francisco Bay Area Rapid Transit District, June 1961, Parsons Brinckerhoff-Tudor-Bechtel, Engineers," describe this general system and determine the engineering feasibility of this general system. Construction plans and specifications remain, of course, to be prepared before construction bids are obtained and construction begins; and circumstances then existing may well result in some variations within the general framework of this and other reports.

B. The estimated total cost of constructing and acquiring such facilities is $937,674,000.

C. The estimated period of construction of such facilities is from January 1, 1964, through December 31, 1970, preceded by a period for design and right of way acquisition starting July 1, 1962.

D. An estimate of the revenues which may be expected to be derived therefrom is:

Fiscal Year	Gross Fare and Concession Revenue	Net Operating Revenue
1968/69	$29,259,000	$10,974,000
1969/70	33,596,000	13,469,000
1970/71	35,950,000	15,529,000
1971/72	37,607,000	15,994,000
1972/73	38,804,000	16,633,000
1973/74	39,415,000	16,935,000
1974/75	39,883,000	17,185,000
1975/76	40,293,000	17,399,000
1976/77	40,712,000	17,622,000
1977/78	41,104,000	17,810,000
1978/79	41,522,000	18,033,000
1979/80	41,912,000	18,242,000
1980/81	42,309,000	18,435,000

E. The amount of bonds which will be required to pay the estimated total cost of constructing and acquiring such facilities is $939,000,000, including incidental expenses of the project and of bond issuance of $920,982, reimbursement to the State of California for rapid transit commission expenses of $405,018, and construction costs of $937,674,000.

F. An estimate of the taxes required to be levied in Alameda, Contra Costa, San Francisco, and San Mateo Counties for all District purposes is:

Fiscal Year	Total Costs Paid from Taxes	Probable Total Tax Rate per $100
1962/63	$ 2,935,000	6c
1963/64	6,769,000	13
1964/65	15,618,000	28
1965/66	25,311,000	44
1966/67	31,937,000	53
1967/68	36,187,000	58
1968/69	37,992,000	58
1969/70	38,704,000	57
1970/71	38,883,000	55
1971/72	45,825,000	63
1972/73	47,336,000	63
1973/74	48,649,000	63
1974/75	49,969,000	63
1975/76	51,282,000	62
1976/77	52,602,000	62
1977/78	53,915,000	62
1978/79	55,235,000	62
1979/80	56,541,000	62
1980/81	57,861,000	62
1981/82	58,491,000	61
1982/83	59,094,000	61
1983/84	59,697,000	61
1984/85	60,300,000	61
1985/86	60,903,000	61
1986/87	61,506,000	61
1987/88	62,109,000	61
1988/89	62,712,000	61
1989/90	63,315,000	61
1990/91 to 1998/99	63,650,000	61*

*District assessed valuation assumed to remain constant at $10.5 billion after 1990/91.

The sole source from which such taxes will be obtained is a general tax levy on the taxable property within the District.

was $2.30 per $100 ass
uation. Combined t
throughout the Bay A
shown a steady increa
period of many year
trend continues in the t
Transit District's 63
will represent an even
centage of the future
total tax rate.

All of these estimate
and annual payments
owners are based on th
tion that the general
bonds will be supporte
from property taxes.
current estimates of
and expenses, this assu
safe and conservative
vides a sound basis on
consider the costs of t
proposal. If future n
exceeds current estima
of these revenues may
to payment of bond in
principal, thus permit
duction in the District

amount of bonds which
equired to pay the esti-
tal cost of constructing
uiring such facilities is
0,000, including inci-
xpenses of the project
nd issuance of $920,982,
sement to the State of
ia for rapid transit com-
expenses of $405,018,
truction costs of $937,-

estimate of the taxes
to be levied in Alameda,
osta, San Francisco, and
eo Counties for all Dis-
poses is:

	Total Costs Paid from Taxes	Probable Total Tax Rate per $100
	$ 2,935,000	6c
	6,769,000	13
	15,618,000	28
	25,311,000	44
	31,937,000	53
	36,187,000	58
	37,992,000	58
	38,704,000	57
	38,883,000	55
	45,825,000	63
	47,336,000	63
	48,649,000	63
	49,969,000	63
1975/76	51,282,000	62
1976/77	52,602,000	62
1977/78	53,915,000	62
1978/79	55,235,000	62
1979/80	56,541,000	62
1980/81	57,861,000	62
1981/82	58,491,000	61
1982/83	59,094,000	61
1983/84	59,697,000	61
1984/85	60,300,000	61
1985/86	60,903,000	61
1986/87	61,506,000	61
1987/88	62,109,000	61
1988/89	62,712,000	61
1989/90	63,315,000	61
1990/91 to 1998/99	63,650,000	61*

*District assessed valuation assumed to remain constant at $10.5 billion after 1990/91.

The sole source from which such taxes will be obtained is a general tax levy on the taxable property within the District.

SUMMARY OF DA
FURNISHED PUR
TO PUBLIC UTILITIES CODE SECTION 29152

A. A general description of the facilities to be acquired and constructed from the proceeds of the proposed bond issue is an adequate, modern, interurban mass transit system extending through the City and County of San Francisco and southward through the County of San Mateo to the vicinity of Palo Alto in the County of Santa Clara and from San Francisco eastward to Oakland in the County of Alameda, from Oakland to the vicinity of Richmond in the County of Contra Costa, from Oakland to the vicinity of Concord in the County of Contra

way acquisition starting July 1, 1962.

D. An estimate of the revenues which may be expected to be derived therefrom is:

Fiscal Year	Gross Fare and Concession Revenue	Net Operating Revenue
1968/69	$29,259,000	$10,974,000
1969/70	33,596,000	13,469,000
1970/71	35,950,000	15,529,000
1971/72	37,607,000	15,994,000
1972/73	38,804,000	16,633,000
1973/74	39,415,000	16,935,000
1974/75	39,883,000	17,185,000
1975/76	40,293,000	17,399,000
1976/77	40,712,000	17,622,000
1977/78	41,104,000	17,810,000
1978/79	41,522,000	18,033,000
1979/80	41,912,000	18,242,000
1980/81	42,309,000	18,435,000